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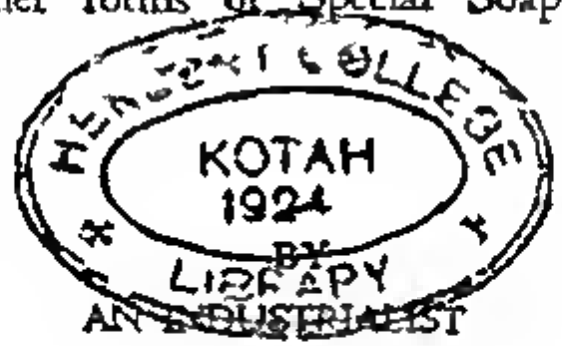
MANUFACTURE OF SOAP

A Manual revealing the Art of Soap Manufacture from the Theoretical and Practical points of view with lots of Tried Recipes for making Washing, Toilet, Medicated and other forms of Special Soaps



INDUSTRY PUBLISHERS LTD.
KESHUB BHABAN,
22, R. G KAR ROAD, SHAMBAZAR, CALCUTTA.

First Edition *July, 1931*
Second Edition *December, 1931*
Third Edition *August, 1933*
Fourth Edition *October, 1935*

CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER I

INTRODUCTION

THE use of soap in some form or other may be traced to very ancient times The first dawn of civilization led man to look out for substances which would help him in scouring his garments, and the outcome of this crying necessity has been the modern soap It marks a great improvement over the primitive pot ashes obtained by burning certain plants, or over the vegetable, mineral and chemical substances like soap nuts, fullers' earth, soda, infusorial earths, etc, but still it is far from being perfect

THE SIGNIFICANCE OF SOAP

The word *soap* is derived from the latin word *sapo,* meaning tallow It leads us to the view that in the European countries the tallow and greases mixed with pot ashes formed the starting point in the manufacture of soap But now a days the meaning of the word soap has been extended to include the products obtained from various fats and oils

We are all familiar with soaps and know the chief purposes they perform but to give a definition of the term is very hazardous and fraught with technical difficulties Definitions have been attempted based on properties and chemical composition of soap Popularly speaking soap is an alkaline or unctuous substance used in washing and cleaning In its strictly chemical sense it refers to some combinations of fatty acids with caustic alkalies which on treatment with water liberate alkali so very helpful in scouring

DETERGENT ACTION OF SOAP

One of the most important properties of soap is the removal of fatty impurities and the abstraction of dirt from various kinds of textiles without injuring the materials An explanation of this detergent action of the soap has been sought for by many scientists The commonly accepted view is that when the soap is dissolved in water a small quantity of alkali is set free It is this free alkali that attacks any greasy matter on the surface of the material to be cleansed and dissolves it This loosens the dirt particles adhering to the fat and renders them easily washable

Exhaustive researches however have shown that the explanation given above is faulty Modern scientists have based their explanations on the emulsifying power of soap solutions Coming in contact with water, the

soap gets *hydrolysed, i e* it is broken up into a fatty acid and a base The emulsion wets and penetrates into oily textures and is capable of entering into a colloidal combination with dirt that adheres to the oil This consequently removes the dirt and the soap itself is carried away when washed in water Still others attribute the detergent action of the soap solution to its property of lubricating the texture and the impurities thus promoting their removal Another view is that the alkali liberated by the action of water on soap helps the contact of the water with the dirty substance and thus greatly facilitates the washing operation

VARIETIES OF SOAP

Various kinds of raw materials enter into the composition of the soap even the same material is available in multifarious grades Hence the properties of the soap exhibit distinct variations according to the nature of the raw materials used Attempts have been made to classify soap chiefly under two broad headings viz , *hard soap* and *soft soap*

HARD AND SOFT SOAP

The soaps which dissolve very moderately in water cannot be easily rubbed on the surface to be cleaned so that only small quantities are rubbed off are technically known as *hard soaps* They do not give lather freely and

being only partially soluble it takes much time and labour to scour a dirty material with these soaps and even then the substance is only partially or imperfectly cleansed

The soft soaps on the other hand, dissolve readily in water give free lather and are very wasteful in use

Hardness or softness of soap depends chiefly upon the alkali used Soaps made with caustic soda are generally harder than those made with caustic potash As a general rule the sodium soaps made from fats or mixtures of semi or non drying oils are hard soaps as distinguished from the potash compounds of the drying oils which are commonly distinguished as soft soaps

CONSISTENCY OF SOAP

Hardness or *softness* of soap has also much to do with the ingredients other than the alkali Consistency of a soap varies with the composition of the oil and fat from which it is made and also with the various filling agents employed Usually tallow, animal fats and coconut oil produce a hard soap having a firm texture while the soap obtained from linseed oil and castor oil are soft in texture Again there are oils which yield soaps which can neither be classed as hard nor soft, e g, mahua, groundnut oil, etc They give soaps of medium consistency The filling agents generally lend a firm body to the soap

Hence in the making of soaps careful attention is to be paid to the selection of the soap stock Neither hard nor soft soaps can find favour with the common customers They would like to have, on the other hand, a soap which combines in one all the good properties that a soap can claim The art of a soap manufacturer consists in blending the various hard soap making and soft soap making elements and the filling agents in proper proportions so that the finished product may be of a quite satisfactory consistency and quality

APPLICATIONS OF SOAPS

Besides these two broad sub divisions there are many varieties of soaps which serve diverse purposes There is first the *domestic soap* which is largely requisitioned for laundry purposes, the washermen as a class consume a great quantity of *laundry soaps* which are generally a bit inferior to the domestic soaps in properties Then there is the *toilet soap* which is necessary for cleansing the person There was a time when the use of toilet soaps was considered by the masses as a luxury which they could ill afford to indulge in large quantities But toilet soaps have now a days met wider popularity Then there are *industrial soaps* required for scouring purposes in the dyeing, woollen, silk and calico industries In factories *cheap soap* and *liquid*

soap are consumed in huge quantities to wash off the hands and cleanse the floor and sundries Special soaps called *marine soaps,* are in demand for use in ships to be used with salt water There is another class of soaps known as *medicated soaps* These include a wide range of articles such as carbolic soap, margosa soap, coal tar soap naphthol soap, camphor soap sulphur soap, etc etc

CHIEF VARIETIES OF SOAPS

Apart from these classifications there is another broad way of classifying the soaps based on their process of manufacture

CURD SOAP is made from tallow only a small portion of lard or coconut oil being added to ameliorate its hardness and give it softness The soap owes its name to the special method of boiling and separating the soap out in the form of curd before being framed Various scented soaps have the pure curd soap as their basis

MILLED SOAP is a settled and fitted soap which has been milled properly This generally refers to the best quality toilet soaps having compact texture and uniform consistency

BAR SOAPS are pale yellow laundry soaps generally obtained by the process of settling and then finished in the shape of bars These were much in demand during the pre war days but they have now fallen into disrepute, their place being occupied by tablet and ball soaps

PALE SOAPS are generally laundry soaps for domestic purposes, have a pale yellow colour and generally contain a fair percentage of rosin to help the lathering property These are made by the boiling process

MOULDED SOAPS are so called because they are moulded in earthen cups more or less of the shape of a hollow hemisphere These have a better soap value than other varieties of washing soaps and are much used by the washermen These are also made by the boiling process but the method of salting out in this case is rather laborious

TABLET SOAPS and BALL SOAPS are so named because of their being finished in the shape of cakes carrying designs and balls having definite weights The names have generally nothing to do with the process of manufacture

MOTTLED SOAP is prepared from refuse kitchen stuff or low grade tallow and presents a marbled or mottled appearance The soap generally contains a small quantity of ferrous sulphate or green vitriol to which it owes its peculiar colour By exposure to the air the iron salt gets oxidised and a reddish tint is diffused over the bluish mottled mass

CASTILE SOAP, otherwise known as *Marseilles Soap* is made from olive oil and caustic soda This is produced both in the white and marbled state for which the addition of a little ferrous sulphate will be

necessary The former is said to be the purest, the latter the strongest The object of marbling the soap with an insoluble matter is to show that it contains but little moisture, since, if too large a proportion of water were present, the colouring matter would sink to the bottom and remain there instead of being diffused throughout the mass

WINDSOR SOAP has generally the curd soap as the basis only a little scent such as oil of carraway supported by a little oil of bergamot, lavender or origanum, musk, etc is incorporated for perfume Brown Windsor soap is nothing but the white variety coloured with a little burnt sugar or that had turned mellow and brown with age

GLYCERINE SOAP is generally a toilet soap from tallow and fats and is essentially a mixture of soap and glycerine The soap is often finished so as to be transparent to view

TRANSPARENT SOAP owes its name to the transparent nature of the finished cake This property is developed by the special method of its manufacture and by incorporating various filling agents

HONEY SOAP is quite a misnomer It contains no honey It is made of good yellow soap scented with the oil of citronella

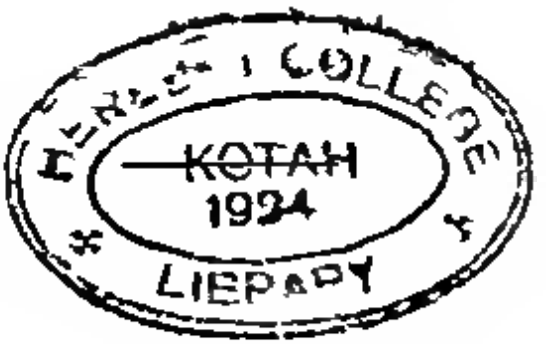
MONOPLE SOAP, much used by the dyers and calico printers is prepared by the complete saponification of some sulphonated oil, preferably castor oil, with caustic soda

MARSEILLES SOAP, also much in vogue among the dyers and calico printers, is prepared much in the same manner as the Monople Soap Simply in this instance sul phonated olive oil is employed in place of sulphonated castor oil

DYE SOAP —These soaps have got the special property that they impart suitable colours to the soap while they cleanse the cloth Various aniline dyes may be incorpo rated in the soap stock for the purpose The manufacture of these soaps may be taken up in India

SHAVING SOAP —As the very name sug gests the soap is used before shaving The soap is made in the form of sticks It should be capable of forming copious lather which persists for a time The soap should be free from excess of alkalis and should be perfectly non irritant

GOLA OR BAGMARI SOAP —This is grain ed soap of high quality prepared in Bagmari, a suburb of Calcutta It is very popular among the *dhobis*



CHAPTER II

RAW MATERIALS IN SOAP MAKING

THE raw materials for soap manufacture cover a wide range of substances which may mainly be classified under the following classes —

(1) Fats and Oils
(2) Alkalies
(3) Rosin
(4) Salt
(5) Filling Agents such as soap stone soda silicate starches etc
(6) Soap Colours
(7) Soap Perfumes
(8) Water

As success in manufacture would depend upon the selection of the raw materials a general description of the raw materials and their chemical properties from the soapmakers point of view will be very instructive These properties are to be kept in view if a particular type of soap fulfilling special conditions is to be manufactured successfully

TALLOW

Tallow is procured chiefly from the fat of cows bullocks buffaloes sheep goats and similar animals It is separated by fusion

from the membranes and fatty matter by *rendering,* a process involving the use of heat and steam

Tallow as available in the market is very variable in quality and colour The tallow obtained from the thick fatty deposits surrounding the abdomen is considered to be of the highest quality and is much used for edible *purposes Inferior qualities of tallow are* obtained from hollow bones of animals and are commonly known as *bone grease, bone fat, bone tallow marrow tallow* etc An oil separates out when melted tallow is allowed to crystallise out This is known as *tallow oil* and is also employed in soap making to some extent The genuineness of tallow can be tested by its specific gravity (0 943 to 0 942) and melting point (42° to 46°C)

When boiled with caustic alkalies of 10° to 12° Be tallow is converted into soap Use of stronger alkalies is inadvisable as the first formed soap will thereby tend to separate out and will hinder further saponification Usually 13 79 to 13 85 per cent of caustic soda or 19 32 to 19 38 per cent of caustic potash is required to convert the tallow into soap Amount of salt to be added for purpose of graining and settling the soap is the smallest in the case of tallow, this being 8 to 10 per cent of the waste lye Chemically speaking, tallow is composed of stearine palmitin and olein in varying quantities

Tallow gives a soap of uniformly compact texture without any objectionable odour It is therefore often blended with other oils and fats to impart firmness or body to the soap Soap from the finest tallow is white but that made from the common varieties appears brown The soap is what is technically known as *hard* soap lathering scantily in water but the great advantage of tallow soaps is their excellent cleansing and keeping properties They are not wasteful in use Though hard on ageing they generally keep well and do not get rancid like soaps made with other oils Another important property of tallow is that its use as a soap stock increases the amount of water that can be added to a soap without an excessive sacrifice of firmness When soaps from oils appear soft tallow soaps are often added to give them a firmer body

Tallow comes from three sources in India viz buffalo oxen and sheep The tallow from buffalo and sheep is pure white in colour and exhibits grains which are a bit firm That from oxen is yellowish with soft grains Australian tallow of the first class is fine white It is the best tallow in the market

Tallow Oil also gives good white soap which is softer than tallow soap

LARD

Another animal fat required in the soap industry is lard which is chiefly composed of

stearine and olein It has got varied uses in medicine and cookery and is rather a costly material It gives a better soap than tallow but owing to its high price it is employed in soap making on a restricted scale being used only in the manufacture of the best grades of toilet and shaving soaps

Lard is the fat separated from the membranes and blood of the hogs The fat which surrounds the kidneys yields the best and finest lard It is white, soft (slightly harder than butter) and pultaceous Some varieties are of faint yellowish or creamy tint

Lard has a specific gravity of 0 931 at 15°C and 0 881 at 50°C Its melting point is 40° to 42°C whilst its solidifying point is 27 1° to 29°C It contains 96 per cent of insoluble fatty acids Lard requires 19 5 per cent of caustic potash for neutralisation and the soap obtained is white, odourless, of uniform texture, and lathers freely in water It does not go rancid on keeping

Lard Oil, an oily substance formed during the manufacture of lard, has been found unsuitable for soap manufacture

COCONUT OIL.

From the Indian soap makers' point of view coconut oil is the most important of the fatty substances suitable for soap making It is available in great abundance on the Malabar and Coromandel Coasts and the lower basins

of the Ganges, the Brahmaputra and the Irrawady The Cochin variety of the coconut oil is the most prized as being free from any free acids and yields soaps of the highest quality Calicut and Alleppey varieties are also good

Coconut oil has a pleasant odour, characteristic of its own Its specific gravity is 0 93 at 15°C and 0 87 at 100°C It melts at 20° to 25°C and remains in the liquid state for the greater part of the year It is saponified readily taking a stronger alkali (20° to 22° Tw) than any other fat at the ordinary temperature with the evolution of much heat It lends itself to the cold process of soap making with the greatest facility But one great drawback which the oil suffers from is that it goes rancid on keeping and gives out an offensive smell The oil consists of stearic palmitic, oleic, myristic and lauric acids as triglycerides and contains small quantities of lower acids, butyric caproic etc

The oil requires 17 4 to 18 7 per cent of caustic soda and 24 5 to 26 per cent of caustic potash for complete neutralisation With weak lyes the saponification is retarded till the lye *gets concentrated to 20° to 22° Tw as* against 10° Tw in the case of tallow The oil fobs considerably and special precautions are to be taken to prevent boiling over During graining the oil requires twice as much salt as tallow or any other oil

Coconut oil yields a good white soap lathering freely in both fresh and salt water The lather, however, is of thin body and lacks permanency, which is a feature of lard soap The oil is therefore made the chief basis in the manufacture of marine and hard water soaps It is capable of taking up a very large percentage of water and filling agents which would go to cheapen the cost of production It is also used in making toilet soaps but the product is rather harsh to delicate skin unless blended with other oils

The soap from coconut oil is fairly hard in consistency but is rubbed off easily It is often used in admixture with tallow to give the soap a greater lathering property This admixture will also prevent cracking of the tallow soap when dried up The yield of glycerine from coconut oil is also great being 12 per cent of the soap The soap however, does not keep well long and is likely to go rancid on long keeping

PALM OIL.

Palm oil is obtained from the fruit of the oil palm (Elacis Guineensis) and in India it is available plentifully only in Burma

The oil varies from a light yellow to a dark red colour and is sometimes of a buttery or tallow like consistency The fatty acids contained in the oil are chiefly palmitic and oleic

From the soap manufacturers' point of view palm oil makes an excellent soap stock yielding a pale soap of a firm texture and compact body It can be treated by the cold process For these having objections to the employment of tallow in the soap stock palm oil will form a good substitute The oil also constitutes a good ingredient in toilet soaps Like tallow it can be used with coconut oil

The oil melts at 27° to 30°C and solidifies at 30° to 40°C according to the age and origin of the oil

The oil requires 14 0 to 14 7 per cent of caustic soda for complete saponification The percentage of caustic potash for the same purpose comes up to 19 7 to 20 3

COTTON SEED OIL.

Cotton seed oil is available in plentiful abundance in India in the cotton bearing tracts and can be used as a soap stock The soap made from crude cotton seed oil is good but the colour is rather dirty But the refined oil is a clean bright oil of a pale yellow colour and produces a white soap but this is liable to be soon discoloured and does not also keep well The oil however may be used in admixture with other fats and oils in suitable proportions

Cotton seed oil has a specific gravity of 0 922 to 0 926 at 15°C The flash point of the oil is 475°F and it solidifies at 0°C to 1°C

It requires 19 5 per cent of caustic potash and 14 per cent of caustic soda for complete neu tralisation The process of saponification in the case of cotton seed oil is rather difficult, the lye remaining in the body of the soap The soap is therefore hard to obtain in a neutral condition Saponification is best begun with caustic lye at 15°Be, addition of soap scraps or admixture with easily saponifiable fats accelerates the operation

The soap also is not so easily grained as tallow soap Cotton seed oil yields a soap of thin body which can be hardened by mixing soda ash and sodium silicate It is darker than the tallow soap and comparatively easily soluble in water It is more soluble in water than tallow soaps and therefore lathers freely but the lather does not last as long as the soap made from tallow and other fats An addition of tallow hence improves the washing property of the soap The soap has a pale reddish tinge and a high detergent property but often gets rancid on long storage The oil is much used in making pale soaps and floating soaps

The oil appears to consist chiefly of the glycerides of palmitic oleic and linolic acids

LINSEED OIL.

India's resources of linseed are quite immense Large crops grow in Bihar and Orissa United Provinces, C P, Hyderabad Bengal Bombay and the Punjab

The oil is rather limpid with a greenish yellow colour It has got extensive applications in arts and industries It is par excellence the most important drying oil of commerce and is much employed for the manufacture of paints The oil is also prized by the soap manufacturers, for the manufacture of special kinds of soaps mainly soft and transparent The glycerides of linolenic acid and isolinolenic acid constitute 60 to 70 per cent of the oil

The oil occurs in various shades of colour (from yellow to light orange) has a specific gravity of 0 935 at 15°C and 0 881 at 100°C, the flash point being 103 140°C The oil requires for complete neutralisation 18 9 per cent of its weight of caustic potash or 13 35 per cent of its weight of caustic soda The saponification takes place readily simply on boiling When the oil is saponified with caustic soda the soap obtained has an unpleasant reddish colour This is what makes the oil useless in the preparation of ordinary domestic soaps But the oil when boiled with caustic potash yields a brownish yellow soap free from any objectionable odour The soap is very soluble lathers profusely and has got a characteristic odour This has got the additional property of giving clear transparent soaps and it is this property which leads to the general preference among the soap manufacturers for linseed oil when soft soaps are

wanted The oil is often used with fish oil and cotton seed oil

CASTOR OIL.

Another oil from the vegetable source is that from castor plant which flourishes most in Madras, Nizam's Territory, Bombay, Central Provinces, United Provinces and Bihar and Orissa The oil can also be used alone or in conjunction with other oils in the manufacture of soaps The oil can be made into soaps by the cold process with great readiness with lye 32° to 34° Be Linseed or coconut oil is often added to soap stocks containing castor oil to improve the lathering property

Castor oil varies in colour from light yellow to dark brown, and possesses a characteristic smell and its specific gravity ranges from 0 960 to 0 970 It solidifies at—18°C The most important constituents of the oil are the glycerides of ricinoleic and dihydroxy stearic acids

The oil gives a very soft soluble soap with caustic soda and is easily saponified It cannot take up much water Castor oil soap is very clear and transparent, therefore it is used in preparing the cheaper kinds of transparent soaps It takes from 12 5 to 13 3 per cent of caustic soda and 17·5 to 18 per cent of caustic potash to saponify it, rather less than that required by the majority of fats and oils A

stronger lye from 15° to 18° Tw can be used and it is easily boiled up The soap lacks in detergent property

GROUNDNUT OIL

Another important soap stock is the groundnut oil which is extracted on a large scale in Madras and Bombay Presidencies The cold drawn oil is a pale limpid liquid of pleasant taste and is mainly used for edible purposes It contains less than 1 0 per cent of free fatty acid The second and third pressure oils are exclusively used by the soap manufacturers

The oil contains the glycerides of arachidic lignoceric palmitic oleic and linolic acid Its specific gravity varies from 0 917 to 0 919 solidifying at 2°C It gives a soap of white soft body the colour depending upon the grade of the oil used The soap gives only scanty lather Hence it is rarely used alone in the manufacture of soaps but is used along with tallow and oils that would give a firm body It is evident therefore that it is not suitable for treatment by cold process It requires 13 56 to 13 93 per cent by weight of caustic soda for neutralisation and 19 13 to 19 66 per cent by weight of caustic potash

MAHUA OIL

Mahua is found in plenty in Bengal Bihar and the greater part of Central India

Mahua oil has come into large use among the soap makers It is cheap and gives a soft body to the soap It is used along with other oils to give a balanced soap stock

The oil is much used in laundry and cheap toilet soaps on account of its low price The oil has a pale yellow colour but oil of light yellow colour is also met with It ranks now a days as one of the most important soap stocks and is generally used in conjunction with coconut oil, tallow, sesamum oil, etc It is often substituted for animal fat

The soap from the mahua oil has a rather soft consistency It gives thin but ample lather When wheat flour is used in the soap as a filler it can absorb much water

The oil requires 11 3 per cent of its weight of caustic soda and 15 8 per cent of caustic potash The soap solidifies after graining at 57°C

SESAMUM OIL.

Sesamum oil is available in large quantities in Upper India and the Madras Presidency It makes a useful soap stock, is light coloured and fairly rich in "stearines" which are deposited on allowing the oil to stand in the cold The oil frequently contains large quantities of fatty acids consisting of a mixture of about 78 per cent of liquid acids (oleic and linolic) and 12 to 15 per cent of solid acids (stearic, etc)

The oil has a specific gravity of 0 923 and requires 13 49 to 13 66 per cent of its own weight of caustic soda and 19 to 19 24 per cent of its weight of caustic potash for complete neutralisation The strength of the lye should best be 36° to 37°Be

On account of the large quantity of fatty acid present in the oil, it does not lend itself to treatment by the cold process The oil, however, can be made into soaps by the boiling process Usually mahua coconut, castor and other oils are mixed with this in the making of laundry soaps to improve the quality

Soaps produced from sesamum oil are white in colour and lather profusely The soap is of medium consistency

FISH OIL

Fish oil in a hydrogenated state is now used in the manufacture of cheap soaps The oil is amenable to treatment by the semi boil ing and boiling process It requires 13 5 per cent of caustic soda and 18 9 per cent of caus tic potash for complete neutralisation

OTHER OILS

Among other oils which may be used in soap making are rape or mustard oil, fish oil, etc , but their use is rather restricted The runnings of mustard oil are used by some manufacturers to reduce the cost of produc tion

Researches conducted by the Department of Industries, Bengal have brought to the forefront a number of oils which now go to waste for want of industrial applications Some of these oils specially *neem oil punnal oil, rayna oil* and *karanja oil* have been found to be suitable for the soap industry They give soaps with good detergent properties and in Bengal which is rather deficient in soap *making materials their use is recommended on* a larger scale than hitherto We are indebted for the following accounts of these oils to the Bulletins published by the Department of Industries, Bengal

NEEM OIL.

Margosa oil, commonly known as Neem oil, is the oil obtained from the seed of *Melia Azadirachta* a large evergreen tree growing wild throughout the greater part of the Indian Peninsula Certain medicinal properties are attributed to the oil which has accordingly some application, a nominal quantity only being used by a few soap makers to make medicinal soaps possessing the odour of the original oil

Neem oil is a stock capable of producing a fairly hard soap and, as such, should be highly valued, since most of cheap soap stocks available from vegetable source in India are of the soft kind The soap from Neem oil is almost as hard as the mahua soap

The oil has a specific gravity of 0 9142 at 16°C and requires 19 69 per cent of caustic potash and 13 93 per cent of caustic soda for complete neutralisation The oil is, therefore, quite suitable for the making of grained soap, moulded or stamped

Neem oil saponifies readily and the soap produces profuse lather which is slightly greasy But the oil gives a perfect washing soap in judicious mixture with other harder and softer stocks, but special treatment is necessary in this case

RAYNA (AMOORA ROHITUKA) OIL

The Rayna grows wild in many forest tracts of India and the neighbouring islands It is found in the moist ravines of the Gonda forests in the United Provinces, in the forests of the Sikkim Terai and lower hills up to 6,000 ft in Assam, Sylhet, Cachar, Chittagong, Northern and Eastern Bengal tropical slopes of the hills of Burma up to 3,000 ft , the evergreen forests of the Western Ghats in Konkan North Kanara and southwards, specially the Anamalies

The fresh oil drawn from rayna has a deep red colour with a cloudiness and an odour which is neither strong nor very disagreeable On standing, the oil becomes clear, and a solid fat separates from it and settles at the bottom, having a colour much less deep than that of the oil itself The fresh oil has a

specific gravity of 0 9016 at 29 5°C and a saponification value of 198 27 *i e*, the oil would require 19 827 per cent of its own weight of caustic potash for saponification

The oil contains a larger proportion of unsaturated fatty acids which impart a soft consistency to the soap made from it while endowing the same with high lathering and detergent qualities The oil can therefore replace linseed oil or other soft stocks commonly used in admixture with the hard soap-producing fats and oils for the proper softening of the body of the soap The oil contains resinous matter which also adds to its cleansing and lathering properties, but at the same time makes it unsuitable for soap making by the cold process It can be used in making moulded soaps The oil does not show any unusual behaviour on boiling with caustic soda, the saponification proceeding normally and the resulting soap graining out rapidly on salting

The colour of the soap does not undergo any change on storage Of scarcely less importance is the resistance which the soap from this oil offers to rancidity Further the slightly aromatic odour which the Rayna oil soap possesses remains intact for a long time

KARANJA (PONGAMIA GLABRA) OIL.

The oil of the seed of Pongamia Glabra, or Karanja as it is popularly known in Bengal and Chota Nagpur, has been known in the

Indian villages for a long time The oil under the name of Pongam oil is used in small quantities in a few soap factories in Southern India for the manufacture of settled soap

The oil has a specific gravity of 0 9297 at 31°C and a saponification value of 185 3 which means it requires 18 53 per cent of its own weight of caustic potash for saponification

The oil contains a compound substance having a disagreeable smell which is passed on to the soap unless removal beforehand by bringing about its decomposition The latter is brought about by protracted boiling with caustic soda in course of saponification The oil cannot therefore be used by itself or in combination with other oils and fats for making soap by the cold process free from objectionable odour

Karanja oil saponifies fairly easily to form a soap of a soft consistency and having good cleansing properties It lathers freely and has a thick greasy feel the latter due to the presence in the oil of some resinous matter which is converted into soap The stock has been found to be suitable for the making of moulded and settled soaps in admixture with other stocks the soaps still possessing good lathering and cleansing properties

Since Karanja oil is a comparatively soft stock moulded soap of the proper degree of hardness cannot be made of a mixture of oils and fats containing more than 25 per cent of

this oil Having regard to the other requirements of the soap it will be found convenient to use the oil in proportion lower than the maximum stated above, for ensuring good body and high cleansing property to the soap Soaps made from mixtures containing higher proportions of Karanja oil than 25 per cent, will dissolve too quickly Such soaps will have a tendency to turn slightly brownish on long storage In a moulded soap, however, a brownish colour is not generally considered so much a disqualification

The soap made entirely from Karanja oil can be grained and moulded, but it develops a dirty brown colour on prolonged storage The soap grained over brine has a solidification point of 39°C as against 66 5°C for tallow, 57°C for mahua oil 54°C for punnal oil 52°C for rayna oil and 45°C for groundnut oil

PUNNAL (CALOPHYLLUM INOPHYLUM) OIL

The proper use of the oil as a soap stock is, however little understood and hence it is being used only in the preparation of the cheap classes of soaps of indifferent qualities

The oil as expressed has a light yellow colour with a greenish tint which deepens on standing The oil has a tendency to deposit particles of solid fat It has a characteristic odour, not very disagreeable, by which it can be identified unmistakably On cooling, the oil begins to thicken at 5°C and becomes a

viscous solid at about 0°C The freshly expressed oil has a specific gravity of 0 932 at 36 5°C and requires 19 4 per cent of its own weight of caustic soda for saponification

The presence of comparatively large proportions of free fatty acids and resinous matter in the oil interferes with the slow and progressive saponification of the stock, so necessary for success in the cold process, and thereby renders the complete saponification of the oil an impossibility

It has been found that the oil is saponified easily on boiling and the soap made entirely from this oil has a dark yellowish brown colour The soap is however, free from odour and has a soft consistency It has good cleansing properties and a very mild action on the skin The lather is quick and abundant.

The brownish colour which the soap develops is calculated to be a disadvantage in the use of the oil by itself In admixture with other stocks however the oil can be used up to 30 per cent with great advantage in the making of all varieties of moulded soaps having high cleansing and lathering properties By refining the oil larger proportions of this stock up to 70 per cent can be used in admixture with other stocks in the making of the above mentioned soaps The refining eliminates most of the resinous matters present in the oil and considered to be responsible for the disadvantageous colouring substance

CAUSTIC SODA.

One of the most important ingredients in soap making is the caustic soda Formerly the caustic soda was made by the manufac turers themselves by treating soda ash with lime water But this method of lye making is now obsolete as caustic soda of reliable quality may be had ready at hand at cheap *prices*

Caustic soda comes into commerce in four forms

(1) sticks,
(2) flakes like scale of fishes,
(3) blocks in casks,
(4) solution

The caustic sticks are however rarely used in soap making on account of their high prices Caustic liquors are not also taken into credit for containing too much impurities Flakes are too costly for large use In fact blocks are mostly in use

Commercial caustic soda is a creamy or white mass, having a slightly fibrous structure It is very hygroscopic, readily absorbing water from the air and passes into a highly caustic liquor It also readily absorbs carbonic acid from the air, passing into carbonate so that it is not desirable that caustic soda should be exposed too much to the air

Caustic soda is sold in the market in a variety of grades, each grade containing a definite percentage of caustic soda

Grade	per cent of caustic soda
60°	77·42
70°	90·32
72°	92·90
74°	95·48
76°	98·06
77°	99·35
77·5°	100·00

The figures indicating the grade have a significance The degrees represent the percentage of sodium oxide present in the alkali The highest grade, containing as it does more available caustic soda and less impurities is much more advantageous to use For example, 77 5° caustic soda means that 77·5 parts by weight of sodium oxide are present in 100 parts of the caustic soda And since from the molecular weight of the caustic soda it appears that 80 parts of the soda contain 62 parts of sodium oxide, 77·5 parts of sodium oxide must be present in 100 parts of the caustic It therefore comes to this that cent per cent pure caustic soda is designated as 77 5°, while a caustic soda of 90·32 per cent purity will contain 70 parts by weight of sodium oxide and will consequently be designated commercially as 70°

The amount of caustic soda required to neutralise various oils and fats is given in the following table:—

	Quantity of Caustic Soda for 100 seers of the oil or fat
Almond Oil	13 4 seers to 14 0 seers
Castor Oil	12 5 „ to 13 6 „
Coconut Oil	17 6 „ to 19 2 „
Cotton Seed Oil	13 8 „ to 14 2
Fish Oil	12 8 „ to 13 9 „
Groundnut Oil	13·3 „ to 14 0 „
Lard	13 9 „ to 14 0 „
Linseed Oil	13 6 „ to 13 9 „
Mohua Oil	11 2 „ to 11·3 „
Mustard Oil	12 4 „ to 12 6 „
Olive Oil	13 2 „ to 14 0 „
Palm Oil	14 0 „ to 14 7 „
Rapeseed Oil	12 0 „ to 12 8 „
Rosin	12 2 „ to 13 8 „
Sesame Oil	13·5 „ to 13 8 „
Sun Flower Oil	13 5 „ to 14·1 „
Tallow	13 8 „ to 14 1 „

CAUSTIC POTASH

Caustic potash possesses chemical properties very simular to those of caustic soda Only it is much stronger in chemical action than the latter in every respect But from the manufacturers' point of view there is an essential difference between the soaps produced with caustic soda and caustic potash As already mentioned (*page 4*) the soaps made with caustic potash are generally softer in consistency and more soluble in water than those

made with caustic soda Hence when soft soaps are to be manufactured caustic potash is requisitioned but it is rarely used in making ordinary domestic soaps In making toilet soaps sometimes a fraction of the total alkali consists of caustic potash

Caustic potash dissolves readily in water forming a lye with considerable evolution of heat It is hygroscopic and readily absorbs carbon dioxide from the air and is converted into potassium carbonate Hence it is of the utmost moment to the manufacturers that the caustic lye should be as little exposed to the air as possible

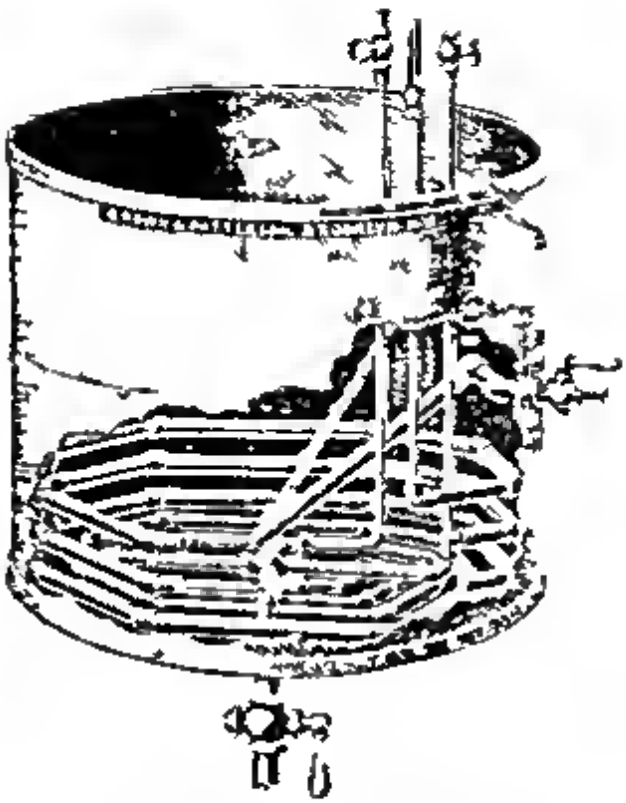
Caustic potash it requires no mention neutralises fatty acids to soap But generally the percentage of the potash is rather higher than in the case of caustic soda Usually 18 5 to 20 p c of pure caustic potash is required for saponification as against 13 to 14 per cent of pure caustic soda As a matter of fact the quantity of caustic potash required to neutra lise a sample of oil is exactly 1 4 times the quantity of caustic soda required for the same purpose

The soaps made with caustic potash are soft and dissolve readily in water The soaps therefore lather more freely

SODIUM CARBONATE

Next in importance among the alkalies is the carbonate of soda Formerly it was con

Fig 1



Section of a Soap Kettle

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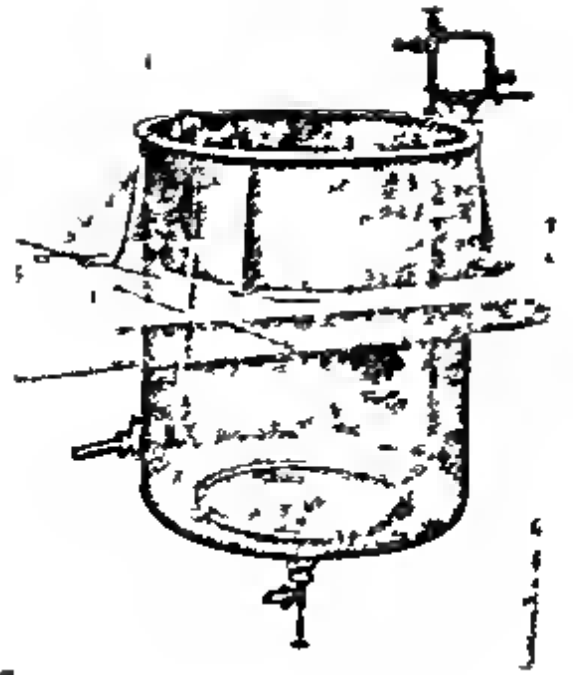
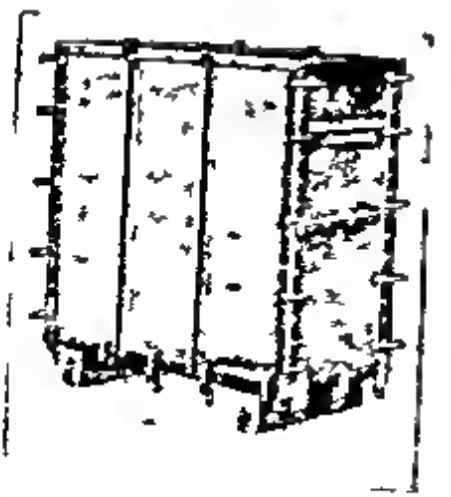
Fig 2.



Soap Boiler for Direct Steam Heating

[Ref page 73

Fig 3



Soap Frames with Screw Clamps

[Ref page 71

sumed in huge quantities by the soap boilers to prepare their lye at the factory but now a-days the caustic soda having come into wider use, the sodium carbonate is rather employed on a restricted scale It cannot be safely used in making soaps from high grade oils and fats and can only be made use of in the preparation of soaps from free fatty acids The carbonate is used by the fullers as such in cleaning dirty cloths and has good detergent properties though it is not quite non injurious to the softer materials

The carbonate of soda occurs in the market in five distinct forms viz soda ash, refined alkali, soda crystals (occurring in large crystals), crystal soda (occurring in small crystals) and bicarbonate of soda Of these soda ash is used to a limited extent by the soap boilers Two forms of it are available, viz caustic soda ash and carbonate ash and possess varying degrees of strength known as 48 degrees 50 degrees, 52 degrees, up to 58 degrees The degrees refer to the amount of alkali present in terms of sodium oxide but expressed as English degrees

SODA ASH 48°, sometimes called caustic soda ash often contains besides carbonate of soda, 4 per cent caustic soda (sodium hydrate) and 10 per cent salt (sodium chloride) together with water and impurities

CARBONATE OF SODA OR SODA ASH 58°, also termed "light ash" and refined alkali, is com

mercially pure sodium carbonate containing about 0 5 per cent salt The 58° represents the English degrees and corresponds to 99 per cent sodium carbonate It is better to use the 58° stuff than the 48° one

SODA CRYSTALS OR WASHING SODA is often added to the soap to the extent of 5 per cent of the soap a larger quantity cannot be used as it would cause much effervescence on the soap This material both cheapens the cost of production and adds to the detergent properties of the soap

Soda crystal is also an important filling agent in so far as it has got detergent properties and prevents loss of soap by softening the hard water during washing This also has a hardening action on the soap It is often added when water is found in excess in the soap or in pale soaps where use is made of resin But a large use is to be avoided as it would cause formation of saline efflorescence on the soap

It is not judicious to use more than 5 to 10 parts of soda to 100 parts of the oil

CARBONATE OF POTASH

The standard for refined carbonate of potash is 90 92 per cent of actual potassium carbonate present although it can be obtained testing 95 98 per cent It has got the same properties as sodium carbonate but is less used than the latter

SALT

Salt is required in large quantities in manufacture of soaps It is mainly used for graining the soap out from a mixture of oils and alkalies Soaps being insoluble in strong brine separate out when salt is added in quantities to make the mixture saline The quantity of salt required for the salting out process in the case of the various oils and fats is a very variable quantity Salt is added solid but sometimes it is made into brine of special strengths before addition to the waste lye The usual quantity of salt to be added to 100 parts of the oil is $12\frac{1}{2}$ parts

ROSIN

Rosin finds wide applications in the manufacture of pale laundry soaps It is brittle and transparent, its colour varying in shade greatly according to the quality of the product For pale soaps only bleached and white rosin can be used, for dark coloured soaps the common varieties can be employed with impunity

Addition of rosin increases the cleansing power of the soap, promotes the formation of lather and ameliorates the firm type of soaps It is also added to form soaps when they are to be softened down But one defect it suffers from is that it often causes stickiness and sweating It is to be added in definite quantities or the soap will be of buttery consistency and lose its firmness The amount of rosin

that can be assimilated by various fats and oils depends on their very nature Good tallow will carry more rosin than soft grease In general, the firmer the soap, the more rosin it is capable of carrying Usually good tallow will absorb about 40 to 50 per cent of rosin, and grease 25 per cent without making the soap excessively soft Rosin can be incorporated in both hard and soft soaps but the soap is rather liable to get darker with age

Rosin requires 12 2 to 13 8 per cent of caustic soda for neutralisation

FILLING AGENTS

The filling agents are intended to increase the bulk of the soap without increasing its cost of production A number of filling agents are employed by the soap manufacturers Particular care should be taken for their selection and the proportion in which they are to be added The addition must not be so heavy as to detract the detergent property of the soap, or affect its keeping quality All these factors are to be reckoned before mixing them

The more important of the filling agents are silicate of soda, starch, sulphate of soda sugar or a combination of them Formerly soap stone silicious matters, kieselguhr were much used but their use is now very restricted as they have no cleansing properties and on the other hand break the grain of the soap and make it wasteful

The most important of the lot is however the silicate of soda and potash, specially the former

SODIUM SILICATE

Sodium silicate is brittle, breaking with a conchoidal fracture and resembles glass Liquid sodium silicate is a viscous liquid (50° Be sp gr 1 50—1 54) Generally it is of an alkaline character and possesses good detergent properties Neutral silicates containing smaller proportion of soda are often used

Usually 5 per cent is the quantity employed in making pale soaps and such a quantity will harden a soap The proportion of the silicate is sometimes increased to 25 per cent If, however, the proportion largely exceeds this then the tendency is for the soap to become pasty and very wasteful in use

The presence of silicate of soda increases the alkalinity of the soap

The detergent properties of the soap do not suffer by such addition though the soap is liable to get a bit strong caustic and wasteful in water Excess of this filling agent however renders the soap thin

Silicate of potash is also used by soap manufacturers specially for mixing with soft soaps.

STARCH

Another filling agent is starch This has got the property of combining with water in

the presence of alkalies into a gelatinous mass soluble in water Hence this is added to make the soap of proper texture when it has got thin without dispensing with its large water The use of starch does not produce any alteration in the appearance of the soap but the detergent property of course deteriorates 2 per cent is, however a fair quantity to use

GLAUBER S SALT

This is another filling agent which has got the property of rendering soap hard But its use is accompanied by a very undesirable deposition of saline efflorescence on the soap which also becomes more wasteful in use and weaker in detergent properties

SOAP STONE

Soap stone, otherwise known as French chalk or talc is often incorporated to the ex tent of 5 to 10 per cent as a filling agent It lacks the detergent properties of silicate or soda crystal and the binding power of starch It simply supplies a mechanical filling agent for the soap

PEARL ASH

Pearl ash imparts to the soap a finer texture due to the double decomposition between the soap and pearl ash The soap is rendered smooth, transparent and hard But excess of it renders the soap soft and pasty

BORAX

Borax has often been suggested as a filling agent especially because it has got a good detergent property But it is rather expensive to be so employed and can hardly go to cheapen the cost of production

Some soap manufacturers make use of a small percentage of borax in their preparations The addition is stated to improve the cleansing power of the soap owing to the feebly alkaline nature of the soap and imparts to it a slight bleaching property

Borax is chemically known as borate of sodium and occurs in fine, rather efflorescent crystals Borax is soluble in half its weight of boiling water and about 12 parts of cold water

SOAP PERFUMES

Soaps made from animal fats and oils are often attended with an unpleasant, if not offensive, smell This has to be masked if the products are to find a ready market With this object in view the manufacturers employ a wide range of cheap scents, natural or synthetic to distinguish the odour of the soap Again toilet and medicated soaps have to be delicately scented For this purpose essential oils of the best qualities are mixed To make the fragrance lasting the use of some fixative agents such as tincture of musk, ambergris, tolu balsam, benzoin, civet, oils of Peru balsam, sandal

wood patchouli cloves aniseed benzyl or ethyl benzoate etc etc is recommended

In selecting perfumes for soap care should be taken that the perfumes have no deleterious effect on the colour of the soap nor disturb the composition of the soap Again suitable blending of perfumes is very much necessary as two unsuitable perfumes may by mutual reaction cancel each other

Clove oil cassia oil heliotropin vanillin when added to the soaps cause them to be discoloured or to darken in keeping Delicate perfumes such as bergamot oils etc should not be added to soaps with free alkalies

NATURAL PERFUMES

A knowledge of the principal natural perfumes used in soaps is necessary for soap makers A list follows —

ANISE OIL —Colourless or at most faintly yellow oil when fresh Has a pleasant odour and an aromatic sweet taste

BERGAMOT OIL —Has a pale yellow colour but is often met with having a greenish tint Has a strong agreeable odour Is largely used in scenting toilet soap Should be kept out of contact with air

OIL OF CARRAWAY —Has a light yellow colour an aromatic odour and burning taste Is largely employed in the scenting of soaps both alone and in combination with other essential oils

OIL OF CASSIA —Yellow but turns dark brown on standing Has a pleasant odour not unlike that of cinnamon but not so pleasant Gives the characteristic odour to Brown Windsor soap and is useful for sweetening coal tar medicated soaps

OIL OF CINNAMON —Viscid, golden yellow or golden brown according to age and has a burning but sweet taste Much used in soaps

OIL OF CITRONELLA —It has a pale yellow colour and a peculiar, pleasant odour Much used by soap makers

OIL OF CLOVES —Colourless but soon becomes yellowish to brown and has a pleasant spicy odour and strong burning taste Is largely used in soap making

OIL OF CORIANDER —Pale yellow colour, pleasant odour, sharp aromatic taste Very largely used in scenting soaps

OIL OF EUCALYPTUS —Is colourless, possesses characteristic odour and is chiefly used in medicated soaps

OIL OF GERANIUM —Used largely in soap making Particularly suitable for use in high class soaps Has an odour like rose

OIL OF LAVENDER —Light yellow colour and a sharp burning taste Only used in high class soap The oil undergoes decomposition in the presence of air

LEMON GRASS OIL —A colourless oil, possessing the scent of roses or rose geranium It is much used in scenting soaps

MIRBANE OIL—Has a strong lasting odour and a pleasant almond colour

NEROLI OIL—Has an odour like orange, and bitter taste It is a cheap scent and is much used

ORANGE OIL—Golden yellow colour yielding the characteristic odour of orange

SANDAL WOOD OIL—This has got the characteristic smell of sandal wood and is yellowish in colour It is much used in toilet soaps

Besides these, quite a large number of essential oils are used by the soap manufacturers, e g, palmarosa oil, oil of sassafras, wintergreen oil, oil of thyme, oil of peppermint oil of nutmeg oil of citron, spike oil, ylang oil, patchouli oil, etc, etc

SYNTHETIC PERFUMES

Synthetic perfumes are, however, being employed to a great extent by the soap manufacturers The more important of them are benzyl butyrate, citral citronellol, coumarine, eugenol, geraniol, heliotropin, ionone, linalol, rhodinol, safrol santalol skatol, terpeneol, etc These are not generally used alone but are blended 2 or more together, to reproduce the odour of some well-known flowers Modifiers are also included to impart a sweet floral touch to the body perfume For example, oil of lavender is modified by coumarine and benzylacetate, jasmine by indol and linalylacetate,

lily by bois de rose femelle and linalol, narcissus by paracresol methyl ether and jasmilone, rose by geraniol and phenylethyl alcohol, and so on

The following basic bodies, amongst others, will bring about a distinct natural tone if suitably blended, writes Mr A N Ghosh, Soap and Oil Technologist, in *Industry*

Lilac—Terpeneol Heliotropin, etc

Violet—Ionone, Irison, Viodoron, Irisoil, Iris Resinoid, etc

Sandalwood—Santalresinoid, Geraniol, Phenylethylalcohol

Jasmine—Benzyl acetate, Indol, Lenalyl-acetate, etc

Orange—Yara Yara (Beta naphthol-ethyl ether), Bromelia (Beta-naphthol ethyl ether), etc

Rose—Geraniol, Rhodinol, Geranilacetate, Hydroxicetronellol, Linalol, Citronellol, Phenylethyl alcohol, Reuniol, etc

Musk—Musk Xylol, Musk ambrette, Benzylbenzoate, etc

Clove—Eugenol, isoeugenol

Goldlack—Iris Recinoid Neroline, etc

May Flower—Linalol, Terpeneol, etc

Almond—Benzaldehydes, etc

Geranium—Diphenylmethane, Diphenyl-ether, etc

Trefle—Amylsalicylate, Heliotropin, etc

Gold lack—Iris Resinoid, Neroline, etc

Hay—Coumarine, Liquid Storax, etc

FIXATIVES

There are various gums and resins which have got the property of fixing the scent of the perfumes added Chief of them are Peru Balsam Tolu Balsam Gum Benzoin, Myrrh, Storax, etc , etc When these are added in the soap they make the scent lasting and do not allow them to pass off too quickly Various tinctures and infusions are also employed for the same purpose The most popular of them infusion ambrette infusion musk, tincture civet tincture iris etc , etc

SOAP COLOURS

In selecting colours for the soap care should be taken that they are not acted upon by alkalies which may be present in the free state in the soap This precludes the use of Prussian Blue, Chrome Yellow Alkali Blue Magenta etc A large number of mineral colours was formerly employed in dyeing soaps such as ultramarine vermilion, chrome green cadmium yellow, caramel, ochres, etc , but as these are liable to separate out from the soap as it cools down and to form speckles unless specially attended to their use has been now a days superseded by coal tar dyes which are highly soluble in soap, can be readily mixed and produce every imaginable shade dark and light, in the soap The colour also should not have any deleterious action on the perfumes and should resemble so far as possi-

ble the colour of the flower whose odour is sought to be reproduced

A list of the more important colours follows —

Yellow—Fluoresceine Yellow Soap Yellow, Quinoline Yellow (water soluble or spirit soluble), Metanil Yellow, Cadmium Yellow, Ochres

Red—Cardinal Red B, Ponceau 2 R

Rose—Ponceau Scarlet, Vermilion

Bright Rose—Brilliant Roses, Rhodamine B

Deep Pink—Erythrosine B

Bluish Pink—Bluish Pink N, Saffranine

Green—Fast Light Green, Ultramarine Green, Chrome Green

Orange—Brilliant Orange G

Brown—Soap Browns Soudan Brown, Caramel Umbers

Blue—Methylene Blue, Ultramarine

Violet—Formyl Violet S4B

A variety of other shades may be obtained by mixing these different colours, e g, a mixture of red and blue will produce violet and lilac tints, blue and yellow greens of various tones, red and yellow scarlet rose, etc

CHAPTER III

PRINCIPLES OF SOAP MANUFACTURE

AS has already been stated the fats and oils essentially consist of glycerides of one or more fatty acids When these are acted upon by water they are split up into the constituent acid and glycerol This phenomenon is known as *hydrolysis* The velocity at which the reaction proceeds is greatly determined by the temperature of the mixture or emulsion of oil and water The higher the temperature the quicker does the hydrolysis go on But there is a point beyond which the hydrolysis cannot take place A reversible reaction sets in as a result of which the fatty acid and glycerol combine together to give the original glyceride and water The process of hydrolysis is therefore never complete

SAPONIFICATION

The hydrolysis would continue if fatty acid is removed from the mixture as soon as it is formed This can be accomplished by the replacement of water by sodium or potassium hydroxide or what are commonly known as caustic soda and caustic potash The fatty acid is converted into constituent sodium and

potassium salts which separate out as soap This phenomenon is known as saponification

When oils and fats are acted upon by alkalies the reaction may be considered to consist of two separate and independent reactions which progress side by side The water in the lye first hydrolyses the fat or oil into some fatty acid and glycerol while the acid in its turn is attacked by the alkali with the separation of soap

WHAT IS SOAP

We have thus a definition of soap and the clue to its manufacture The word *soap* is applied to what is really a mixture of alkali salts of the higher fatty acids and water Various inorganic salts and mineral matters may also be incorporated in the body of the soap

The crucial point in the manufacture of soap is to select an oil or fat that can be saponified and treat it with an alkali Mineral oils cannot be saponified and hence these can by no means be used in soap making Even the vegetable oils and fats adulterated with mineral oils are ill suited for the purpose

The next important feature in soap making is to arrive at a complete saponification of the oil There should be no free acid and fat present in the soap, for that promotes rancidity of the soap On the other hand the alkali must not be present in the free state in

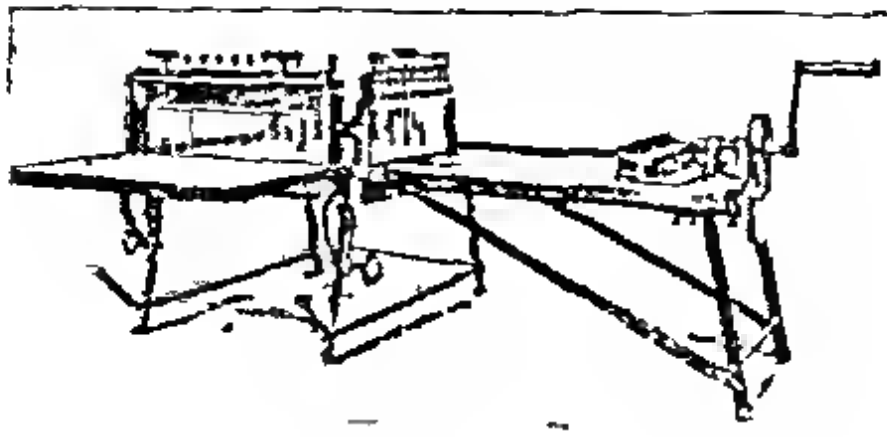
an excessive quantity A slight alkalinity of the soap is allowable but not the slightest presence of free fat

HOW SAPONIFICATION PROCEEDS

For the best results in soap making, i e, for securing complete saponification, the treatment of the oil with the caustic alkali requires particular care Each oil requires a definite percentage of its own weight of the caustic alkali for complete neutralisation and the reaction must also be allowed to take place at definite temperature The concentration of the caustic alkali has also much to do with soap boiling Some oils are only saponified with strong alkalies while others are acted upon by weak alkalies The strength of the alkali also controls the commencement of the saponification operation It has been found that the addition of soap scraps to the oils which are only difficultly saponifiable accele rates the reaction The passing of superheat ed steam within the soap stock in the kettle is often successful in starting the saponification

The employment of a stronger alkali than is appropriate for the particular soap stock in use is to be guarded against The strong alkali acts too quickly upon the oil which is then thrown out as grains of soap from the oil emulsion and retards further saponification For similar reasons weak alkalies will fail to

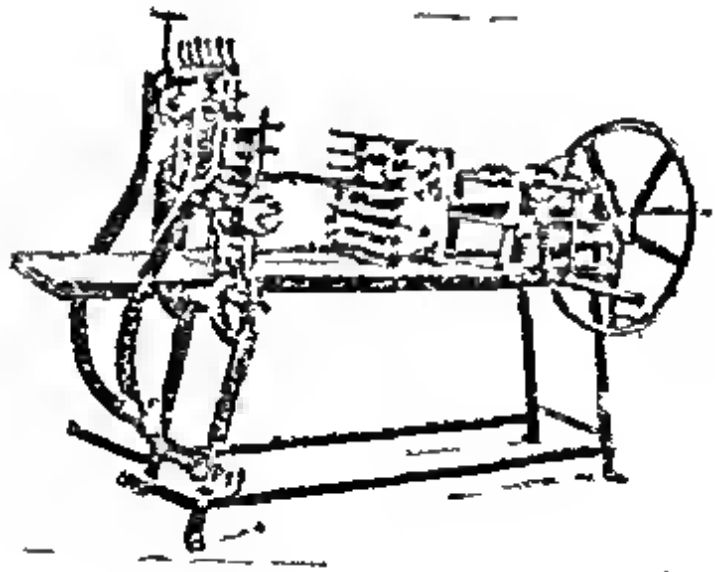
FIG 4



Slabbing Machine

[Ref page 76

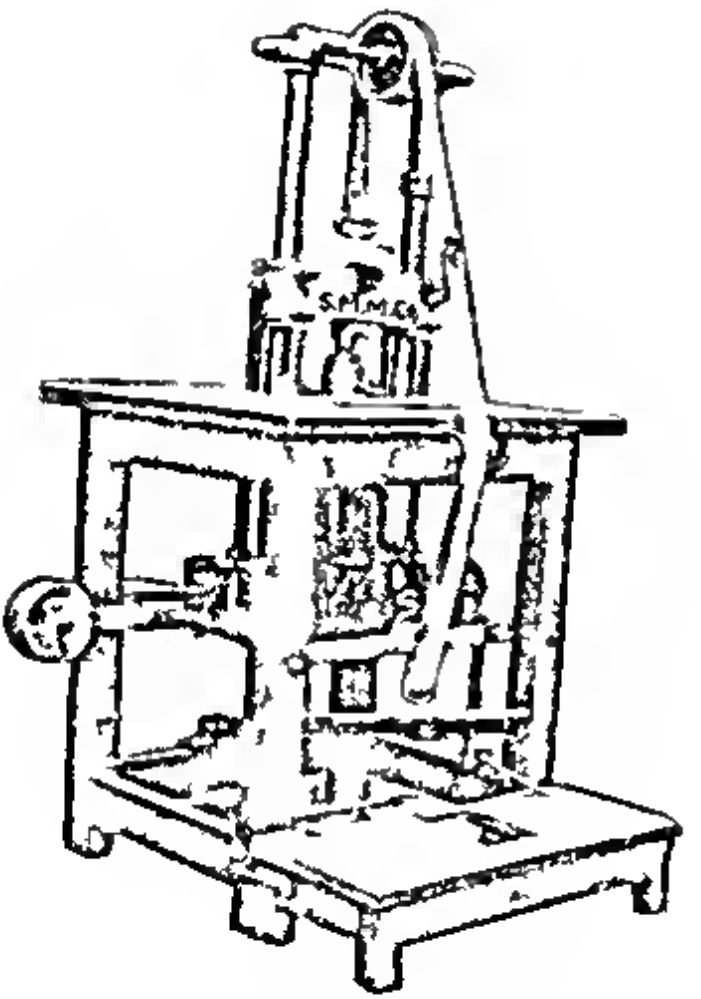
FIG 5



Barring Machine

[Ref page 77

FIG 6



Soap Stamping Machine

[*Ref page 78*

act on the oil till it has got the appropriate strength by evaporation

This explains the phenomenon often met with during the boiling of soap If to a boiling soap a strong alkali be added, the soap at once exhibits grains and "opens," *i e*, the soapy mass becomes curdy and the waste lye at the bottom of the boiler is perceptible But when water is added to the grained soap, it is hydrolysed once again and the whole assumes a "close' appearance and loses its grainy structure This is known as *closing* the soap

MODES OF MANUFACTURE.

The manufacture of soap is possible either in the cold without heating or by boiling The various processes of soap making lend themselves to the following classifications —

(1) Cold Process
(2) Semi boiling Process
(3) Boiling Process

In the cold process the oil, alkali and water combine together to give soap without the separation of anything In the semi boil ing process the soap is obtained by boiling but the waste lye is not separated while in the boil ing process the lye is separated

COLD PROCESS SOAPS

The manufacture of soaps by the cold process dates back to very old times and is the simplest of the lot It essentially consists in

adding to melted fats just sufficient alkali that will ensure saponification and produce a neutral soap The fats and oils which are to be used as soap stock are just heated so that the fats are melted and the oils give out a cracking sound when a few drops of water are poured over them These are then brought in contact with caustic lye and allowed to stand for a few days The saponification goes on and the heat generated during the process accelerates the subsequent action

The crux of the problem is the proportion of soda to be added to complete the process of saponification If the oils and fats were primary substances consisting simply of olein or stearin or palmitin or laurin the matter would have been much simplified In that case chemical equations would give us the exact proportions between the glyceride and caustic soda on the one hand and the soap and glycerine produced on the other But as a matter of fact the oils used are a most heterogeneous mixture of a large number of glycerides and the proportions between them even in the same oil vary considerably according to the source quality and age of the substance

Hence the best way to arrive at a correct percentage between the fat and the oil is to make an independent chemical analysis before treatment of each batch of oil The usual procedure adopted is as follows —

DETERMINATION OF CAUSTIC SODA REQUIRED

A wide-mouthed flask of about 4 to 6 oz capacity provided with a glass tube passing through the cork measuring 3 ft long and ½ in wide is taken 2 grams of oil or fat to be tested is taken into it Now an alcoholic solution of caustic potash is made by dissolving 30 grams of pure caustic potash in 1 000 c c of alcohol To the flask add 25 c c of this alcoholic solution and heat on water bath for half an hour shaking at intervals The soap is saponified by this time As a general rule there should be an excess of alkali in the flask and the amount of alkali present after saponification is to be found out To do this one should have a fair knowledge of acidimetry and alkalimetry The test solution in the flask is diluted with water and is coloured red h, the addition of a little phenolphthalein Now take a semi normal solution of sulphuric acid in a graduated burette and triturate Note the number (X) of c c 's of acid added for discharging the pink colour Now in another basin take 25 c c of alcoholic solution boil on water bath dilute with water, colour with phenolphthalein and triturate as before with semi normal sulphuric acid and note the number (Y) of c c 's of acid used It appears therefore (Y X) c c of semi normal solution of sulphuric acid is just sufficient to neutralise the caustic potash that went to saponify the 2 grams of oil taken It therefore follows that

(Y X) c c of semi normal solution of caustic potash saponified the 2 grams of oil Now 1 c c of semi normal caustic potash contains 0 028 grs of caustic potash Hence the total weight of pure caustic potash to saponify 2 grs of oil is equal to (Y X)× 028 grs whence by multiplying by 50 the percentage of potash to be used can be found out

In the case of caustic soda the multiplying factor is 0 02 in place of 0 028

Thus by chemical tests we have ready at hand the percentage of caustic soda to be used for saponifying various oils In a particular case let us use a batch of 1 maund of tallow 2 maunds of coconut oil and 3 maunds of mahua oil Let the respective percentages as found by tests be x, y, z This means that for 100 maunds of tallow we require for saponi fication x maunds of pure caustic soda *i e* for 1 maund we require x/100 maunds of caustic soda Similarly for 2 mds of coconut oil and 3 mds of mahua oil we require respectively 2y/100 and 3z/100 mds of caus tic soda Hence the total amount of soda to be added for complete neutralisation is

$$\frac{x}{100}+\frac{2y}{100}+\frac{3z}{100}\ \text{mds}$$

Again if the soda in use be not cent per cent pure but commercial say of 90 per cent. strength we would require more of the soda for saponification A strength of 90 per cent

means that 90 maunds of pure caustic soda are present in 100 maunds of commercial soda, whence we find that $\frac{x+2y+3z}{100}$ mds of pure soda will be found in $\frac{x+2y+3z}{100} \times \frac{100}{90}$ mds of commercial soda This is the exact quantity of soda to be added so that the neutralisation point may be reached Usually a little more is added to effect saponification

PROCEDURE

The coconut oil is best adapted for treatment by cold process but other fats like tallow can also be so treated In all cases, however, it is the practice to incorporate a certain percentage of coconut oil in the batch, the saponification of which is thereby accelerated Castor and mahua oils also may be made into soap by this process

In making the soap put the fat or oil in a pan provided with an agitator The fat or oil is then just heated to (70—80 F) When melted run in the lye at the ordinary temperature into the pan and stir constantly The mass will thicken Now run into low and broad frames holding $2\frac{1}{2}$ to $3\frac{1}{2}$ mds and cover the frames with sacking This will retain just sufficient heat to ensure proper saponification, which takes place actually in the frame

Particular care should be taken that fats and oils are of pure quality and free from fatty acid If fatty acids be present the oil is to be treated to rectify it If this is not done the soap will be curdy and not uniform. The fat or oil should be at the correct temperature If it is too cold it will set on the addition of the lye If too hot the saponification proceeds too quickly resulting in curdy or grainy soaps Strength of the alkali is a decisive factor The alkali should be of the highest grade so that the impurities do not get into the soap during saponification and spoil the appearance by causing efflorescence

SEMI BOILING PROCESS

According to this process fatty acids are made to combine direct with alkalies which are taken in proportions so that complete saturation of the fatty acids may be ensured

First of all it is necessary to find out the percentage of alkali required to saturate an oil This has already been given in the case of the various fats and oils For example coconut oil requires 17 48 to 19 05 per cent of its own weight of caustic soda for complete neutralisation The above fact will give us a fair idea about the quantity of alkali to be taken to saponify a given amount of oil The alkali is made into lyes of appropriate strengths The fats or oils are brought to a boil and the alkali is stirred in slowly little

by little Boiling is continued with alkalies of greater and greater strength until all the alkali has been absorbed Water is added from time to time to keep the mass thin and homogeneous Finally frame and allow to cool

During saponification the oil swells up considerably in size and special precautionary measures may be taken to prevent boiling over The use of an agitator is recommended for the purpose, the addition of the oils in small portions at a time is also materially helpful

BOILING PROCESS

The oils and fats are placed in a large pan and is melted by heating Caustic soda lye is then gradually added into the mass kept in a state of ebullition by boiling The strength of the caustic solution and the quantity added from time to time is determined by the nature of the oil At the outset weak lyes must be added slowly until saponification is well under way This is indicated by the formation of an emulsion When the saponification has once begun continue boiling and go on adding caustic soda lye of greater strength in small quantities as long as it is being absorbed so that much evaporation is not needed at the end to arrive at proper consistency But the liquor should not be allowed to become too strong, for then the soap paste is cut into curds upon which the alkali cannot satisfactorily act Water therefore is added from time to time

The emulsion should thicken gradually as the saponification proceeds The concentration of the lye in the kettle is ascertained by taking out a small sample with a trowel from the pan from time to time and applying a little of the cooled sample on the tongue The strength of the alkali can be felt from the intensity of the caustic taste Add caustic soda so long the strength of the caustic soda falls down When no more alkali is used up or the strength remains unchanged the saponification may be considered for ordinary purposes to be complete *i e* the fats and oils taken in the pan have been neutralised by the caustic soda

TESTING FOR SAPONIFICATION

Besides the tongue test, there are other tests to see if the saponification is complete or not Expert soap makers can detect this from the changes of colour grain firmness and general appearance They take out a sample of soap with a trowel and examine it When there is no greasiness in the sample and it feels firm and dry when pressed between the fingers and thumb the soap is considered to be properly saponified and ready for being framed

The following tests taken from Bulletin No 31 of the Department of Industries, Bengal will be found materially helpful to the newcomers in the line

Usually the solution, after the completion of the saponification becomes clear and

assumes a brownish colour The completion of the saponification is also ascertained by the following test, which is called the "ring test" A quantity of the soap is taken in a trowel and a drop from it is caught on a glass pane, or a slate, or the clean floor This drop should be watched as it cools If, in cooling, the edge of the drop solidifies first to form a white ring, and the central portion remains transparent until it gradually solidifies, the solidification proceeding from the edge towards the centre, then the saponification is complete If secondly, the drop in solidifying forms something like a ring in the edge but the central portion is turbid before solidification and the solidification is irregular then it indicates the presence of unsaponified fat or oil If thirdly, the drop solidifies without the formation of the ring, and a watery substance separates from the solidified soap, the fact shows that the alkali is present in excess

The completion of the saponification can also be ascertained by the "ribbon test," as it is called A quantity of the soap is taken on a trowel and allowed to trickle down from it If in so doing the soap forms transparent ribbons it indicates that the saponification is almost complete A turbid ribbon discloses the presence of unsaponified fat or oil If again, the soap, in falling from the trowel shows a solidified but broken film, which glides down readily, the fact indicates that the alkali

is in excess The ring test, or the ribbon test, is often good enough, but it cannot distinguish between a very slight excess or deficiency of the alkali which can only be detected by the tongue test The end of the saponification should be made when a slight excess of alkali persists even after continuing the boiling

The pan now contains saponified fat or soap, excess of alkali and glycerol mixed together If the soap is to be of good quality, either the excess of alkali must be removed from the soap or the soap is to be separated out from the mass and the waste lye may be treated for recovery of glycerol, if possible

GRAINING OUT OR SALTING OUT

The separating out of the soap still in solution from the mixture is accomplished by the addition of salt This happens because soap is insoluble in a strong saline solution

When the saponification point has been reached and the soap is still on the boil and has assumed a thick consistency a saturated solution of common salt 40°Tw is added little by little, to throw out the soap If salting is started when the soap is diluted a large amount of salt will be required Instead of using brine solution, salt may be spread uniformly on the surface The boiling is continued *slowly* The soap loses its smooth transparent appearance and becomes granular

and opaque This is technically known as "opening" the soap

The amount of salt required for the operation changes with the nature of the raw materials used When tallow is employed as a soap stock, the soap is grained easily, more salt is, however, required in the case of cotton seed oil soaps while the amount to be mixed is the greatest in the case of coconut oil soap

Excess of salt should not be added to the mass for graining, for then the soap will become granular and enclose salt Only a sufficient quantity of the salt for the completion of the operation is necessary Hence the most practical way of doing this is to go on adding the salt little by little and test the grained soap from time to time The soap becomes turbid and frothy on the addition of salt The operation is deemed complete when the frothy soap tends to separate in clots and the soap separates at the top without enclosing much froth and air bubbles or a sample taken out on a wooden trowel presents distinct grains of soap and a liquid portion The boiling is then stopped and the contents of the kettle are allowed to stand

CLEANSING THE SOAP

The contents of the kettle being allowed to settle, these separate out in three distinct layers The first consists of a thin crust floating at the top of the pan The second

layer is the actual soap which floats on the saline liquor or waste lye, which forms the lowest stratum in the pan For ordinary purposes the soap may be ladled out carefully from above the waste lye without disturbing it or the waste lye may be withdrawn from the pan by means of a syphon or a pump provided with suitable skimmers The waste lye may be run into tanks for the recovery of glycerine contained in it

The grained soap is then boiled with sufficient water The granules begin to swell up and fuse together or "close" as it is called The soap has now a smooth appearance If necessary the grains may be broken during the boiling with a crutcher This when cooled and framed gives the ordinary soaps of commerce

BOILING ON STRENGTH

The soap is now ready but it may still contain traces of unsaponified fat In the case of better quality soaps and toilet soaps this cannot be allowed to remain in that condition, for it would then go rancid and spoil the perfumes added With this object in view the *boiling on strength* is carried on

The "closed" soap as obtained after cleansing is treated with more alkali which is run in gradually until the soap is again grained and the boiling is continued As the lye is being absorbed add another portion slowly till the contents refuse to absorb more and is

thrown out of solution and grained. Now continue boiling so that last traces of neutral oil may be completely saturated with the oil.

The soap solution is then just "opened" with salt. At this stage it is important to adjust the quantity of salt carefully. The soap is made just to open so that the homogeneity of the mass may be lost and the separated lye visible from above. But the soap must not be allowed to be unduly grained. The pan is then removed from the fire and allowed to rest for several hours. The half-spent lye settles at the bottom of the pan and can be withdrawn. This can be utilized for saponifying poorer quality of soaps, the details of which follow at the end of this chapter.

FITTING.

The soap has not been freed from the presence of unsaponified fat but the excess of alkali in it is now to be got rid of. This is done by *fitting*.

The soap is again boiled and water is added until the desired degree of closing is attained. As the water is thoroughly mixed throughout the mass, the thick paste gradually becomes reduced to a smooth thin consistence. Samples are tested from time to time: the thin layer should drop off a hot trowel held sideways in two or three flakes and leave the surface of the trowel clean and dry. If too much water has been mixed with the soap and

too fine a *fit* is produced which would be denoted by the layer of soap not leaving the trowel a little caustic lye or brine may be very carefully added and the whole well boiled until the desired condition is obtained If the soap is properly fitted all the impurities will be precipitated on standing and the settled soap, containing the correct amount of water, will look clear and bright

SETTLING

The fitted soap is then well covered up to keep up the heat and allowed to stand for 1 or 2 days according to the size of the charge During this settling the contents of the pan separate into three layers, the top consisting of good molten soap (*neat soap or goods*), the intermediate is a slimy soap much richer in water (*nigers*) and the excess or liquor at the bottom

The top layer of neat soap is skimmed off and placed in frames to cool and solidify The nigers are run into another pan to be further treated

The composition of the three layers is as follows —

	Water	Anhydrous Soap	Salt and free alkali
Top layer (neat Soap)	30 to 35 p c	63 to 68 p c	0 5 to 1 p c
Intermediate layer (Nigers)	55 to 65 p c	35 to 45 p c	1 5 to 3 0 p c.
Under layer (Liquors)	93 to 97 p c.	nil	3.0 to 5 0 p c

If filling agents colour and perfumes are to be incorporated in the soap these are to be crutched in or mixed with agitation into the body of soap before it is put in the frame to cool The cooled soap is then trimmed for the market The principles of making toilet and other soaps will be found in their place

MODIFIED BOILING PROCESS

The following method of manufacturing soap based on the German method of soap boiling is suggested in a bulletin published by the Department of Industries Bengal The time of boiling in this case is considerably shortened

The process consists in the use of a considerable excess of caustic soda in a fairly strong solution to initiate the reactions the speed of which is maintained undiminished to the last by the caustic soda which is always present in excess of the consumable quantity A general description of the process is given below

A strong caustic soda lye is taken in a soap boiling pan The exact strength and volume of the lye will depend on the proportions and combining weights of the different oils and fats making up a charge It has been found that for charges containing small proportions only of coconut oil the proportion of caustic soda should be 23 per cent of the entire charge of oils and fats For charges with high

proportions of coconut oil the caustic strength should be raised up to 28 per cent Heat should be applied to the pan after the caustic soda lye has been run in and as soon as the latter commences boiling the mixture of oils and fats is added preferably in a thin stream or a spray so that the contents of the pan may not go off the boil The strength of the lye has an important bearing on the speed of the reaction The best results are obtained with a concentration in which the oils immediately on addition break up with much swelling into minute globules and the saponification proceeds immediately with extreme rapidity A too strong lye causes the oil to grain out at once the grains enclosing much unsaponified oil while with a weak lye no swelling takes place and therefore the action is less brisk The strength of the lye should be found out for each type of soap charge with the help of the above indications In a very short time the charge is practically completely saponified. At the end of the boiling the soap is separated from the lye by allowing the latter to run off through the outlet at the bottom of the pan

The pan should however have outlets for soap and spent l quor and since in the case of application of direct heat an outlet at the centre of the bottom has a short life of efficient service the pan may be made a rectangular one with a flat bottom and a protruding corner at the end of which the outlet pipe is to be fitted

well outside the zone of direct heat. Where steam is to be used for soap boiling, the pan may be made of the usual design.

The partly spent lye withdrawn from the soap boiling pan will still contain much caustic soda of a fairly high strength to saponify a further charge of oils and fats In a separate pan this part-spent caustic lye is treated with a fresh batch of oils and fats The object being the recovery of the alkali, complete saponification is not aimed at Oils and fats in quantities in excess of those completely saponifiable by the alkali present in this lye are added in order that the entire quantity of the alkali may be taken up The alkali, still of a fairly high strength, attacks the oils at once and is used up in a short time When no more free alkali is left, as ascertained by the tongue test or by any other test, the partly saponified charge is separated by means of salt. This partly saponified charge is returned to the first pan towards the end of the saponification of a fresh charge of oils and fats, so that the final product may be a completely saponified soap The operations may thus be carried on in a cycle

An alternative way of using the part-spent caustic lye is to add to it only such a quantity of oils and fats as can be completely saponified by the caustic soda present in it, allowing for a very slight excess of the alkali to be left free in the end to ensure complete saponification.

ADVANTAGES OF THE METHOD

The following are the special advantages of the new method —

(i) The saponification begins and ends in a strongly caustic medium which always keeps the soap separate from the lye The impurities disengaged from the oil during boiling have therefore little chance of returning to the soap mass The result is that more decolorisation and leodorisation take place than are practicable by the use of dilute caustic lyes according to the usual processes

(ii) The process being a continuous one the spent lye is not rejected until it has been made to give up all the caustic alkali contained in it There is no wastage of caustic soda and the cost of production of the soap is therefore lowered

(iii) The time taken to complete the saponification of any charge is considerably shortened a saving in fuel and labour being the result

(iv) Direct heated pans may be used and of as large a size as desired since no risk of overheating is involved and therefore no stirring arrangement is required the soap getting no chance to touch the bottom of the pan In fact the entire daily charge for a soap factory however big can be saponified in a single pan of as large a size as required the furnace being provided with a suitably large fireplace with as many fire doors as necessary

(v) The necessity of repeating again and again the tedious process of boiling on strength in the manufacture of superior soaps, as in the settling process, may be entirely dispensed with, the necessary completeness of saponification being obtained by one boil, or at the most two, in strong caustic lye

UTILIZATION OF SALTED LYE

The following methods of utilising salted lye after the separation of the soap are taken from a Bulletin published by the Department of Industries, Bengal

The salted lye after the separation of the soap contains varying degrees of free caustic To recover it the lye is to be added to the next charge of oils and fats and the quantities should be so regulated that the stock would remain in an emulsified condition and must not merely float on the lye The mixture should then be heated and the reaction would thereby be accelerated and the taking up of free caustic completed For the final separation of the stock mixture a quantity of completely spent lye of a previous charge may be added instead of fresh salt till the separation of the slimy soap is complete The lye which contains no caustic can be thrown away or stored up for the salting of other similar charges By this process the stock becomes saponified to a certain extent and much colouring and odorous matter are eliminated The

partly saponified stock is to be next taken up for regular saponification and salting, resulting in a very pale soap containing very little or no odour, depending on the nature of the stock mixture.

If it is found that the spent lye coming from the saponification charges contains too little caustic to saponify the charge to a sufficient extent so as not to allow any oil to separate, a little free caustic may be added, care being taken not to go so far beyond the emulsification point as to cause the separation of oil and soap. By the addition of an excess, the reaction will be hindered greatly and much more time will be taken to bring about the complete recovery of the caustic.

Another way in which the lye can be utilized will be as follows: In factory practice, spent lyes of different charges frequently await reaction till the next day or so. When such cases arise it is best not to allow the lye to cool but to put it directly into fresh stock for emulsificaion so that the reaction may proceed overnight with the heat of the lye and the final reaction completed on the following day in the least possible time with very little expenditure on fuel. A further reduction in the cost of production can thus be effected.

USING THE SILICATE OF SODA.

Mention may here be made that the soap is often given a charge of silicate of soda or

washing soda to give firmness to the soap body especially that containing rosin The methods of incorporating them follow

Before the silicate of soda is used in the soap stock it should be dissolved in hot water It should be noted that the silicate is sparingly soluble in cold water and settles down in the bottom in that case The strength of the silicate solution should not exceed 40° Be As a general rule by mixing equal parts of water and silicate a strength equal to 40° Be is obtained To get lesser strengths the proportion of water should be increased

While soap is being made by cold process it should be the practice of the manufacturers to add the silicate in solution when the oil and the lye are well mixed Brisk agitation is essential during the mixing operation otherwise the stock is liable to set in places and to present lumps in its body which is most undesirable

During manufacturing of soap by the boiling process the silicate should be poured in when the saponification is completed and the stock is yet of a thin consistency Both the soap stock and the silicate solution should be hot before they are mixed together Vigorous stirring is to be made during mixing with wooden poles otherwise lumps are liable to form within the mass of the soap Sodium silicate usually requires one fifth its weight of caustic soda of 38°Be for action

Silicate of soda may also be added to the oil in some cases before it is treated by caustic soda for saponification

USING SODA ASH

The soda ash may be added in a powdery form when the saponification is nearing completion or in the form of a lye dissolved in water while the saponification is still going on In the first case water is generally added to the soap to thin it down before the addition of the solid while in the latter case the usual proportion of soda ash and water is 1 to 2

Care should be taken not to add strong soda ash solution to a firm soap because this renders the soap brittle This can be added to weak soaps only because this enables the soap to carry more water than pure soap Usually strengths of the solution should be 16 to 34°Be

Soda crystals may be melted direct on fire These give a solution which can be added to hot soaps provided it is weak bodied or thinned down by the addition of water

When pearl ash is used a solution of 2½° to 5°Be is to be preferred

Reference may in this connection be made to Liquoring of Soap in Chapter V

CHAPTER IV

FACTORY EQUIPMENTS

AMONG the special equipments of a factory may be mentioned the furnace, the kettle the frames, the slabbing barring and stamping machines But when business is sought to be done on a big scale, there should be in addition to these appliances various other machines such as crutchers, scrapers, remelters, mixers, crushers, soap drying chamber, etc, etc

FURNACE

The first requisite in the manufacture of soap is the construction of the furnace, the size of which would depend upon the size of the boiling pan and the quantity of stock to be treated in a single batch A raised platform is constructed of brick with an opening in the middle to serve at the top of the furnace The platform is supported by a number of pillars so that there may be a narrow open space leading slantingly upwards to the opening The fireplace is made at one side, at the extremity of this passage Iron gratings are placed for proper airing The ash pit is left just below the gratings The mouth of the furnace is provided with a suitable dumper

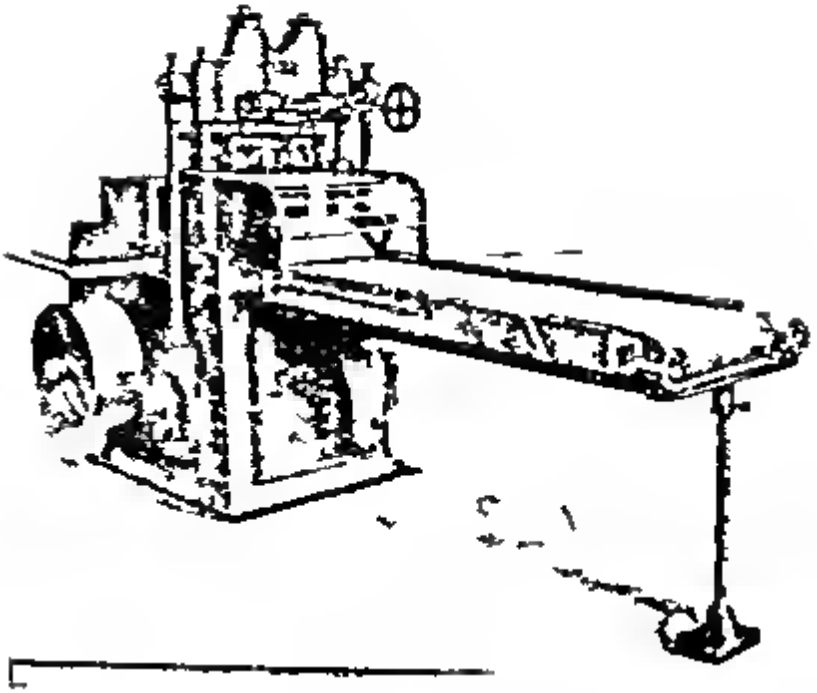
On the side opposite the fireplace there is a chimney connected with the central opening for the escape of the smoke. The operators can take their stand on the platform and work the mass It the pan be very high, stools or ladder may be provided for the purpose.

Either coal or fuel is fed into the fireplace over the gratings and set fire to The flame does not directly heat the pan which tightly fits the opening of the furnace The flame is carried along the narrow alley provided for the purpose and heats the contents of the pan. The dumper is adjusted for proper circulation of air into the furnace.

The furnace should permit of the regulation of heat with ease In the furnace just described, this can be achieved without much difficulty When the temperature is wanted to be raised more coal or fuel may be charged into the furnace and extent of the air hole may be increased so that more air can pass and help the vigorous burning of the combustible material When a lower temperature is desired the size of the air hole may be diminished with the result that the burning of the combustible substances slows down appreciably If the furnace is charged with fuel, some of it may also be drawn out while in the case of coal furnace ashes may be spread over the coal for immediate reduction of temperature

Ordinary furnaces for heating purposes are quite sufficient for the boiling of soap but

Fig. 7



Automatic Soap Press

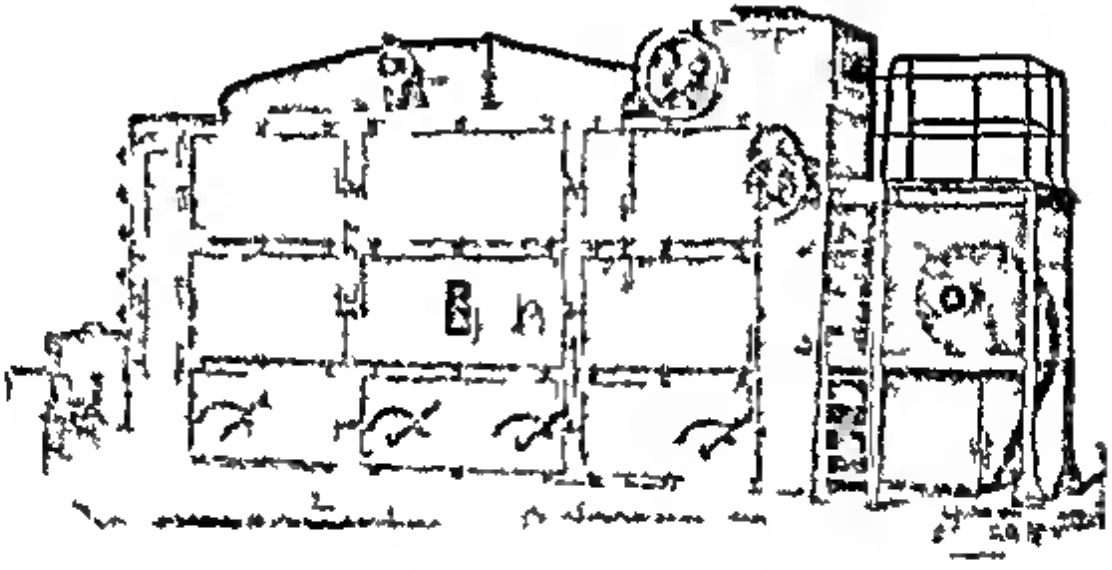
[Ref page 78

Fig. 8

Soap Chipping Machine

[Ref page 79

Fig. 9



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in modern factories where large masses of soap stock are to be treated the furnace is altogether done away with The heating is done with steam which is made to pass through closed or open pipes through the mass of the soap stock This not only facilitates the equal heating of the entire mass but also prevents charring of the mass just in contact with the bottom of the pan The injection of live steam within the mass of the soap helps saponification and closing of the soap

SOAP KETTLES

Soap is ordinarily made in open wrought iron pans made up in one piece But when large masses of soaps are to be treated at the same time, the pan is made of several pieces riveted together firmly It somewhat resembles the cauldrons of the confectioners in shape but is much bigger and deeper, the depth being more than the diameter Usually a cubical content of 5 maunds has to be allowed for every maund of oil and fat to be treated at a time For example if 6 maunds of soap is to be boiled the capacity of the pan should be 30 maunds This allowance is made as soap is liable to froth up tremendously during boiling and would otherwise flow over for nothing and this may end in disaster

In big factories the ordinary boiling pans are replaced by soap kettles which are provided with coils all through the volume of the

kettle Steam from the boilers is made to circulate through the coils In common pans heated from below the contents are not heated equally, mainly because the soap is a non conductor of heat But in the soap kettles with several sets of coils arranged systematically the equal heating of the entire mass may be easily assured

SOAP FRAMES

Soap frames are essentially nothing but big and narrow rectangular boxes with removable sides and are intended for the cooling of the finished soap, to be subsequently slabbed, barred and stamped These may be constructed either of wood or of iron sheet or galvanised sheets but in every case care should be exercised that the sides permit of being removed or built up whenever necessary without the least difficulty or delay and the cooling proceeds on gradually without any leaking of soap whatsoever The shape and size of the frames depend upon the rate of cooling most congenial for the manufacture of a particular type of soap and vary in each case according to the requirements of each individual case If the cooling is to be hastened the extent of the surface exposed should be fairly large and sheets should be rather thin while in cases where the heat is to be conserved for a long time the surface exposed should be comparatively small, the thickness of the side plates

should be great and the thermal conductivity of the material making up the plates should be low For example, soap in a box made of wood would cool more slowly than in an exactly equally made box of galvanised sheet Another point to be considered is the lateral pressure of the soap The strength of the plates should be sufficient to counterpoise it and the thickness should not be so small that the plate would give way The most common size is, however, 45 inches long, 15 inches wide and 45 inches deep but boxes of other sizes are also called into requisition

The wooden soap frames are rarely made of single planks on each side A number of stout frames of wooden beams, the sides fitting tightly into grooves may be constructed, each being of the same internal dimension and an approximate height of 3 to 5 inches They are placed one upon the other when a big shaped rectangular frame will be automatically formed But the frames being not rigidly connected with one another are very apt to be deflected from the normal position Hence a number of rods are passed through the four corners and along the sides vertically down through the beams and are tightly screwed to keep all the individual frames rigidly fixed in position The rods should be capable of being removed easily whenever necessary and the several parts may be unloosened from one another The wooden frames are now out of-

date and are used only during the manufacture of mottled and cold process soaps

The soap frames used in modern factories are generally made of galvanised iron sheets in the shape of narrow high boxes They have a stout wooden base which is mounted on wheels and can thus be carried from place to place without difficulty All round the base are vertically erected wrought or cast iron sheets so fixed as to make a rectangular box of the dimensions 45 ×15′ × 45′ To keep the plates vertically fixed against pressure from within these are tightened by means of clamps which are easily worked In certain forms of the frames the portions of the sides are prolonged into lugs containing holes through which the rods are made to pass binding the ends of frames against the sides the ends of the rods being secured by screw nuts In some patterns of soap frames the ends of the frame are made to fit into grooves in the sides making as tight a joint as possible.

The soap frame has a removable cover which can be put in when the soap has been run into the frames Weights placed on the lid give better results regarding the graining of soap

SLABBING MACHINE

The soap emerges from the soap frame in the shape of huge rectangular blocks which after scraping and trimming are ready to be

slabbed and then cut into bars. The slabbing operation can be performed with a long piece of steel wire provided with huge handles at the two ends. The block is first marked all round by a scribe to divide it into a number of slabs of uniform thickness. The wire is then placed just over the mark and then drawn through. This separates a slab from the main block. The drawing operation may then be repeated to cut the whole block into slabs.

Slabbing machines based on the principle just enumerated are available in the market. A frame containing horizontal wires placed at equal distances apart makes up the cutting arrangement and this can be drawn in uniformly by means of chains and windlass or the block can be mechanically pushed through the frame of equidistant wires.

BARRING MACHINES.

The slabs of soaps are next cut into uniform bars with barring machines of which there are several types available in the market. Essentially the machine consists of an upright frame with fixed wires adjustable at suitable distances apart. The slab is placed on the table while the frame is made to hang overhead. By suitable adjustments the frame is let go and in falling down it cuts through the slab dividing it into bars. Any scrapings formed during cutting are collected into a drawer below and may be re-used. The

barring machines may be employed in cutting the bars into pieces as desired by adjusting the distance of the wires

Modern machines of improved types have been invented to cut the slabs of soaps into bars and the bars into pieces by one and the same operation

STAMPING MACHINES

Bar soaps are now out of date the pieces are generally decently stamped with the names of the manufacturers on one side and trade marks on the other

The stamping operation can be done with hand machines of which the most important part is the die for pressing the soap in By changing the die various designs can be im printed on the tablets The die consists of two halves and are from time to time moistened with a little salt water or glycerine to over come stickiness The soap is sometimes made into a double cake joined side ways or a single cake as desired Several types of stamping machines have arrangements for pressing all the sides up and forming a mould In such cases when the tablet has been formed the sides fall down to the original position but the tablet is left there to be removed by hand before giving the second piece to be similarly punched

Of late years stamping machines worked by foot have been put in the market The

great advantage of the machine is that both the hands of the operator are free for placing and removing the cakes of soap The force necessary for stamping a cake is derived from the swing of the pendulum which only has to be set in motion Sometimes provision is made for counter weights in order to bring back easily and quickly the upper stamp to its starting position

CHIPPING MACHINE FOR SOAP BARS

The soap chipper is intended for reducing the soap bars to shavings It consists essentially of vertical rotating discs fastened to an iron frame and carries a number of plain and toothed knives fixed in slits The bar placed in the feed channel presses against the disc, the slightly projecting knives of which cut shavings off from the front side The knives are adjustable and can thus be made to produce shavings of different thickness which are caught in a box placed underneath Some shaving machines are also made in such a way that the knives can be easily and quickly removed either for cleaning or adjustment to any thickness of shavings desired This can be done by lifting up the front side of the box

SOAP DRYING MACHINES

To dry the soap shavings these are placed on trays which are again filled into racks The racks are then placed in a room heated

by steam pipes When the amount of water is between 15 to 10 per cent, the drying operation is stopped Elaborate machines for the purpose are also available

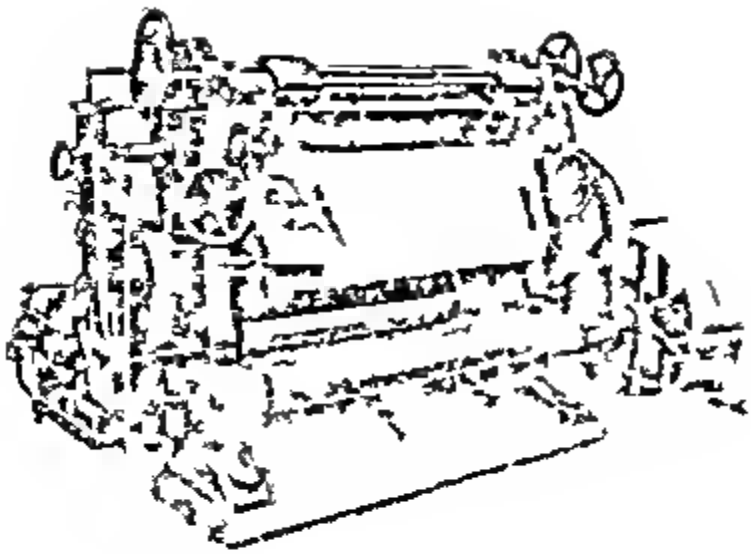
SOAP MIXER

Mixing machines are intended for mixing the dried soap shavings from the chipping machine with colours and perfumes It has a cylindrical tub provided with a cover on the upper open side to close the vessel hermetically when it is in action An axle runs through the middle of the tub to which paddles are fixed This is made to revolve by suitable gearing and the motion of the paddles causes the soap to become mixed and form a homoge neous mass Crutching is necessary when filling the washing soap with silicates or in perfuming and colouring toilet soaps

SOAP CRUSHER

Soap crushers are intended for crushing the dried soap shavings and incorporating scents and colours when milling the soap thoroughly The machine is provided with a number of rollers made of polished and veinless granite The roller can be adjusted according to the fineness of the spans by means of an adjustable device of the first and third rollers against the second (middle) roller There are two hoppers in the machine The shavings fed into the lower hopper travel

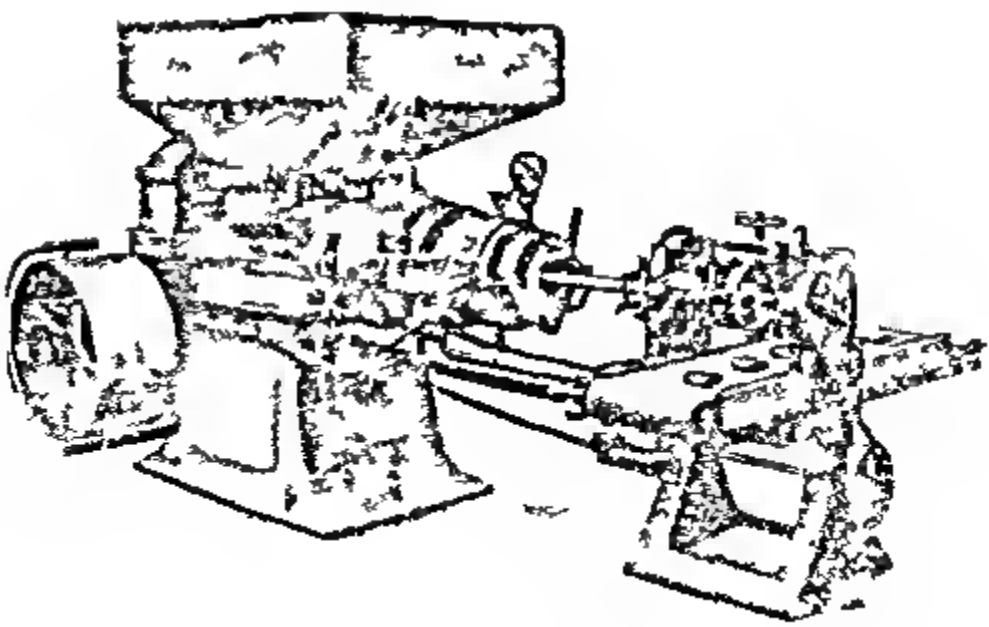
Fig 10



Soap Rubb ng Machine

[Ref page 80

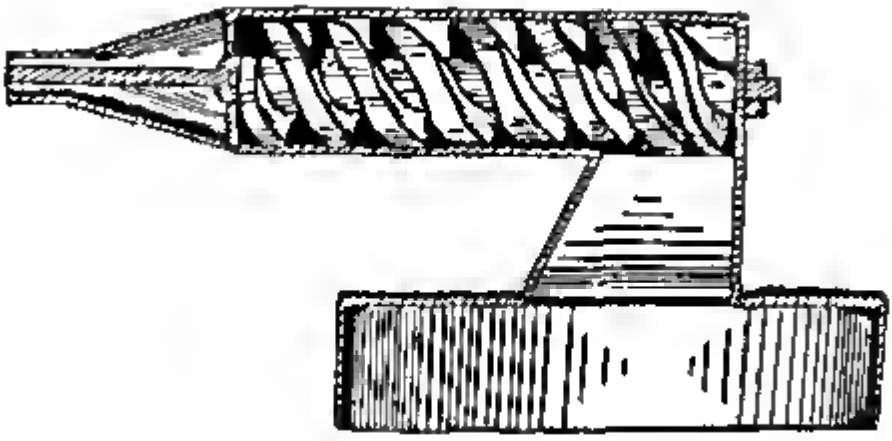
Fig 11



Screw Plodder

[Ref page 81

FIG 12.



Section of Screw Plodder

[*Ref page 81*

between the rollers and occupy the top hopper A steel or wooden comb is used to scrape the hopper and the mixture is again allowed to drop into the lower hopper by taking off the slide When the soap is crushed fine, colours and perfumes are added and the process is repeated three or four times when a homogeneous mass is obtained

SQUEEZING MACHINE (SCREW PLODDER)

The plodder is a machine which compresses the coloured and perfumed soap after being milled into a solid compact mass and then ejects it in the form of a bar which is divided into cakes of the desired size Machines of various construction are employed for this purpose, however, every one corresponds in its essential parts with the others Usually the machine rests upon a firmly mounted frame and consists of a hollow cylinder provided with a hopper The cylinder contains a screw shaft turned by an arrangement of cog wheels The forepart of the cylinder is conical in shape and has double walls at the end for heating and cooling purposes At the end of the front cone there is an arrangement by which the soap is delivered A roller feeds the worm in a perfectly uniform automatic and safe manner The feed hopper is very large, so that it can take very considerable quantities of soap and any recharging or pushing forward of the charge

of the soap by hand is thereby done away with

DISINTEGRATORS

In making soap powders, use is made by soap makers of disintegrators These are of inestimable value in powdering dried chips of soap and save much manual labour It also breaks the lumps which occur in soap powders

APPLIANCES

A number of other appliances is required for soap making The chief among them are a long wooden stirrer, an iron scratcher to scratch the soap adhering to the sides of the vessel, iron tanks for lye making, toothed gauging sticks, hydrometers, etc , etc

CHAPTER V

PRELIMINARY OPERATIONS IN SOAP MAKING.

THE principles of the manufacture of soap have already been given but for success in manufacture the soap boilers have to follow a regular scheme of working and to adhere to only correct manipulations Preliminary operations in soap making follow

SOFTENING WATER.

The first point demanding the attention of the manufacturer is the purification of the raw materials he uses during manufacture He has to examine whether the water available in the factory is soft or hard, *i e* whether it lathers readily with soap or not If the water be what is chemically designated as soft, *i e* if it produces lather with soap readily, no preliminary treatment is to be undergone, but when it is not so special treatment is necessary to prevent much waste of soap during manufacture due to deposition of scum.

To soften water the degree of hardness is to be first ascertained by experiments Then lime water and sodium carbonate are added to the water in proper proportions to rectify the hardness The water is then

boiled For detailed process reference may be made to any text book of Chemistry

REFINING OF TALLOW

Indian cattle being lean and underfed the tallow obtained in this country is of poor quality Moreover, the commercial grades of tallow are often adulterated and fail to give the good quality soap The process of refining tallow is given in Bulletin No 30 published by the Department of Industries, Bengal which is reproduced here for the efficacy and simplicity of the process

The crude tallow is melted in a deep iron pan in which a quantity of water about equal in quantity to the tallow to be refined, is added The pan is better provided with cocks at different levels for the drawing off of the melted tallow On heating the pan, the water begins to boil and the tallow floats on the surface of the water as a layer The whole thing is boiled for about an hour with frequent stirring of the mass During this operation, all the impurities of the tallow are taken up by the water including dirt and also particles of flesh and blood The heat is then stopped and the tallow floating at the top as a clear layer is either syphoned off or drawn off through decanting cocks and allowed to solidify in separate vessels The last portions of the tallow, however, remain at the top grazing the surface of the water and cannot be drawn

off On allowing the whole thing to cool, the last portions of the tallow solidify as a crust and much of the impurities adhere to the bottom of the crust The solid crust is taken out and the impurities scraped and returned to the pan The solid crust if not pure enough, may be added in a subsequent charge for purification

The water in the pan consists of much tallow mixed with impurities and is treated as follows Heavy particles of flesh are taken out by means of a perforated ladle as these consume a large quantity of chemicals and interfere with the recovery of the tallow as soap but the sinews are not to be removed as they contain a certain quantity of combined tallow Caustic soda solution is then added gradually and the mass boiled when the sinews and the minute particles of flesh dissolve and the tallow becomes saponified with the formation of soap The boiling is continued with the addition of caustic soda till the alkali persists which can be readily ascertained by testing the solution on the tongue A biting sensation indicates that the alkali is in excess During the process all the tallow contained in the water used for the purification becomes saponified with the formation of soap The flesh and blood particles dissolve with the formation of glue The solution is next boiled to a thick consistency and salt is gradually added to induce the separation of soap

During the addition of salt the boiling is continued and the separation of soap at the top is noted before each addition of salt As soon as the soap begins to collect at the surface, the addition of salt is discontinued and the mass is boiled for some time to allow all the soap to separate on the surface When all the soap formed has separated, the mass is allowed to cool On cooling, the soap solidifies at the top as a solid crust The soap thus separated is free from solid impurities which remain behind in the lye, but the soap being separated from a glue solution is not suitable for being moulded or made into frame soaps or worked up with fresh charges of soap as it still contains much soluble impurities To further purify this, the soap is dissolved in a small quantity of water and separated again with the addition of salt when most of the soluble impurities of the soap remains behind in the lye The soap after the second salting, though not suitable for direct moulding or forming into frame soap, can be worked with fresh charges of soap in a soap factory The recovered soap from the impurities may with advantage be used for inferior batches of soap, if so desired, using the refined tallow for only first class soaps

NECESSITY FOR REFINING OIL.

Almost all sorts of oils are fitted for being made into soaps but to attain a high excel

lence of the products only the unadulterated oils can be used The presence of impurities in the oil such as the dissolved colouring matters, free fatty acids and other undesirable ingredients seriously affect the colour, odour, appearance and keeping qualities of the soap The presence of dust, earth, sticks, etc in the oil is not very much injurious as they are drawn out along with glycerine during the graining process But it is quite otherwise when the oil is to be treated by the cold process In such cases at least the sticks and solid matters must be eliminated by allowing the oil to settle for some time, otherwise they would mar the soap If the colouring matters present in the oil are not removed prior to boiling the oil for saponification, the final product will develop a dark and dirty colour which is to be particularly avoided Deodorisation of the foul smelling oils is of the greatest moment If this is not properly done the soap will emit a most unpleasant odour which will verily go against it during marketing the stock Of course with the employment of high grade oils the e bleaching and deodorising operations may be dispensed with but the cost of the stock will in that circumstance be rather high The manufacturers have, however, found it profitable to use a certain percentage of cheap oils in their soap stocks By refining these oils in their factory they can further increase the percentage of the low-priced oils in their

soap stock without appreciably lowering the quality of the soap

PURIFICATION OF OILS AND FATS

The following method of refining oils and fats for soap makers' use is gathered from a Bulletin published by the Department of Industries, Bengal

PURIFICATION WITH WATER

The oil or fat to be purified is to be taken in a round bottomed iron pan of a size suitable for the quantity of stock to be dealt with, the oil or fat filling up to nearly half the pan Water of a volume equal to that of the oil should then be run into the pan The little empty space left in the pan will be enough for the boiling as there will be no fear of the contents swelling up like soap The oil or fat, being lighter, floats on the water The contents of the pan are next boiled for one to two hours depending on the quantity of impurities present in the original oil or fat No harm is done by heating the pan over direct fire, because the oil forms the upper layer and never comes in contact with the bottom of the pan In some cases, however a little froth is noticed The boiling should in such cases be continued until the froth disappears It is essential that a state of brisk boiling be maintained during the process The agitation of the contents caused by ebullition is more help

ful than any mechanical stirring device in bringing all the oil and water in repeated close contacts The treatment leaves the oil in a condition in which it can quickly settle the impurities On the conclusion of boiling the pan is left undisturbed for a sufficiently long time to allow of proper settling of impurities The clear oil collects at the top and all the mucilageous matter is found collected in a layer of emulsified oil between the clear oil and the water After the settling of the impurities, the supernatant clear oil is taken off, leaving the layer of emulsified oil If the oil has a chance to solidify on cooling, it has to be removed while still hot, or it may be allowed to solidify and the impurities that will be found in the bottom side scraped off

RECOVERY OF OIL FROM EMULSIFIED LAYER

The thickness of the emulsified layer depends on the nature of the oil Coconut oil and tallow, for example, do not, for all practical purposes emulsify, while linseed oil emulsifies very readily Mowha and *karanja* oils have intermediate emulsifying powers, the latter surpassing the former Linseed oil which emulsifies readily take long to separate into oil and water again When, therefore, such oils are treated according to the method just described, considerable quantities of the oil are held by the emulsion from which it separates out only very slowly The purifica

tion process is thus made a very lengthy one and it is therefore not advisable to treat them singly In admixture with coconut oil and tallow, however, they have been found to separate readily It is therefore recommended that the oils, with high emulsifying powers should, for the purpose of purification, be mixed with oils with low emulsifying powers

The emulsified layer, containing the mucilageous and other light impurities, is filtered through cloth The filtrate consisting of a clean mixture of oil and water is added to the next charge, the impurities being separated and retained by the filtering cloth It will thus be seen that no oil will be wasted in the process of refining, the impurities being the only thing eliminated

The purification of the oil by the above process should be undertaken as and when the oil is required for saponification If much time is allowed to elapse between the purification and the saponification, the purified oil may develop a fresh objectionable odour without redeveloping colour

PURIFICATION WITH SPENT LYE

For oils which have a bad odour with or without an objectionable colour, the course of treatment with boiling water is not enough The oil or fat is to be boiled over the spent liquor obtained on salting a pan It is essential that the spent liquor should contain enough

salt to prevent the stock to be purified from forming an emulsion with the lye, or the dissolving, in the latter, of any soap which is formed as a result of the partial saponification of the stock with the caustic soda present in the spent lye This process removes the odour to a great extent, unless the same is present in an excessive amount in which case a more rigorous treatment will be necessary

PURIFICATION WITH CAUSTIC SODA

When the stock contains much odorous and colouring matters associated with resinous bodies, the simple boiling over spent lye containing a little free caustic soda will not meet the end Examples of such cases are neem oil and grease from bones In these cases the stock is to be added to the spent lye and boiled to nearly complete saponification This necessitates the addition to the spent lye of just enough oil or fat which can be saponified by the free alkali present in it It is sometimes an advantage to supplement the caustic originally present in the spent lye with fresh caustic to get through a larger quantity of oils and fats and to utilize the lye medium for the elimination of as much colouring and odorous matters as possible When the saponification proceeds over the spent lye, the oil medium carrying the odorous and colouring matters is converted into soap with the result that the colouring matter is disengaged and

discharged into the lye and the odorous matter escapes along with the steam The oil thus purified and converted into soap is next added to the main soap charge for the production of high grade soaps consistently with the general quality of the raw material and without any of the disabilities due to the colouring and odorous matters

As the process entails the boiling of large quantities of lye for the treatment of limited quantities of soap stock, the operation is best carried on economically in shallow pans over the flues of regular soap boiling furnaces It will be seen that the heat that is usually wasted will be utilized in the recovery of all the caustic soda in the spent lye and at the same time in purifying, or treating up to saponification, very inferior stocks and making them suitable for good quality soaps

BLEACHING THE OIL.

The fact is that the colouring matter in the original seed is in the form of a powder and passes as such into the oil It can therefore be bleached by allowing it to pass through a percolator charged with animal charcoal which absorbs the colouring matters A similar object is achieved by dehydrating the colouring matter with sulphuric acid, which causes the colouring matters to get charred and to coagulate The charred masses can then be removed by filtration

DEODORISING THE OIL

Where the retention of the characteristic flavour of an oil is not desired, the oil is first heated to a temperature higher than the boiling point of water and is further treated in what is called a deodoriser Oils intended to be treated in this way should be as nearly neutral as possible, as oils showing excess of acidity cannot be satisfactorily treated Deodorisers may be either of atmospheric or vacuum type In the former type the oil is subjected to the heat of both closed and open steam coils The former raises the temperature of the oil to that of the steam while the latter keeps the oil in an exceedingly vigorous state of ebullition so that the unpleasant odours escape into the atmosphere

In the vacuum type of deodorisers, the oil is similarly treated but at reduced temperatures and pressures, and in consequence there is less likelihood of damage to the oil

MAKING CAUSTIC LYE

Lyes for soap making are prepared by dissolving in water the solid caustic hydroxides The commercial caustic soda is usually supplied in large drums which require to be broken open before the caustic, they contain, can be dissolved This caustic is dissolved in iron tanks with a suitable quantity of water The correct way of doing this is to suspend the solid caustic at the top of the tank just

underneath the surface of the water used to dissolve it, then the lye as it is formed, being heavier than the surrounding water, sinks to the bottom, so that the solid caustic, by reason of the currents thus set up, is always coming in contact with fresh water or unsaturated lye, and consequently soon becomes dissolved This may be carried out by placing a perforated iron plate just under the surface of the water or liquor in the tanks The solid caustic may be broken out of the drums and thrown on it

Caustic soda lyes should not be kept too long exposed to the atmosphere, as they tend to absorb carbonic acid and pass into carbonate of soda, the alkaline or soap making strength being thereby reduced It is better to prepare the lye freshly whenever required Soda lyes of any strength may be made from the solid caustic

CONCENTRATION OF THE LYE

The concentration of the lye required for saponification varies with the nature of the oil to be treated Strong and weak solutions are both to be made The strength can either be expressed by mentioning the quantities of the water and the soda in full or by giving the specific gravity or degrees as recorded either by a Twaddle's or Beaume's Hydrometer In the first case there is no difficulty in preparing the solution but the preparation of a solution

of a definite specific gravity from the waste lye becomes a difficult operation In such causes the specific gravity of the waste liquor is to be first determined and then the further quantity to be added is to be calculated out Considered from all points of view it is more convenient and easy to use the Twaddle s or Beaume s hydrometer In preparing the lye of a given strength the caustic is added to water little at a time and the lye is then allowed to cool The hydrometer is to be put into the solution and the mark to which the hydrometer sinks gives the strength of the lye If greater strength is to be attained more soda is to be added till the correct reading is obtained If the strength is already too high the lye is to be diluted with more water In each case the lye is allowed to come to normal temperature btfore any reading is taken by the hydrometer For soap making manufacturers should procure a hydrometer meant for liquids heavier than water The graduations in a Beaume s hydrometer are based on the principle that the point to which the hydrometer sinks in pure water is marked 0° and the point to which it sinks in a 10 per cent solution of common salt (at 17°C) is marked 10° One hydrometer graduated 0°—50° will serve the purpose of soap makers

The approximate quantities of caustic soda to be added to 100 parts of water to obtain lyes of different strengths follow

Strength of the Lye	Water	Caustic Soda (77°)
5° Be	100 parts	3·56 parts
10° Be	100 „	7·4 „
15° Be	100 „	11·45 „
20° Be	100 „	16·78 „
25° Be	100 „	22·84 „
27° Be	100 „	26·36 „
28° Be	100 „	27·58 „
30° Be	100 „	31·05 „
32° Be	100 „	34·66 „
33° Be	100 „	36·68 „
35° Be	100 „	41·16 „
36° Be	100 „	43·33 „
37° Be	100 „	45·91 „
38° Be	100 „	48·38 „
40° Be	100 „	54·17 „
42° Be	100 „	60·44 „
44° Be	100 „	67·38 „
45° Be	100 „	69·64 „

RELATION BETWEEN SP GRAVITY, DEGREES BEAUME AND TWADDLE

Two sets of formula showing the relation between specific gravity and the degrees registered by a Twaddle's hydrometer may be found useful

$$\text{Specific Gravity} = \frac{\text{Degrees Twaddle} \times 5 + 1000}{1000}$$

$$\text{Degrees Twaddle} = \frac{\text{Specific Gravity} \times 1000 - 1000}{5}$$

There is, however, no definite formula establishing the relation between the specific gravity and the Beaume's degrees. The following table connecting the Twaddle, Beaume and Specific Gravity figures may be found useful.

Degrees Beaume	Degrees Twaddle	Specific Gravity
1	1 4	1 007
2	2 8	1 014
3	4 4	1 022
4	5 8	1 029
5	7 4	1 036
6	9 0	1 045
7	10 4	1 052
8	12 0	1 060
9	13 4	1 067
10	15 0	1 075
11	16 6	1 083
12	18 2	1 091
13	20 0	1 100
14	21 6	1 108
15	23 2	1 116
16	25 0	1 125
17	26 8	1 134
18	28 4	1 142
19	30 4	1 152
20	32 4	1 162
21	34 2	1 171
22	36 0	1 180
23	38 0	1 190
24	40 0	1 200
25	42 0	1 210
26	44 0	1 220
27	46 2	1 231
28	48 2	1 241
29	50 4	1 252
30	52 6	1 263
31	54 8	1 274
32	57 0	1 285

Degrees Beaume	Degrees Twaddle	Specific Gravity
33	59 4	1 297
34	61 6	1 308
35	64 0	1 320
36	66 4	1 332
37	69 0	1 345
38	71 4	1 357
39	74 0	1 370
40	76 6	1 383
41	79 4	1 397
42	82 0	1 410
43	84 8	1 424
44	87 6	1 438
45	90 6	1 453
46	93 6	1 468
47	96 6	1 483
48	99 6	1 498
49	102 8	1 514
50	106 0	1 530
52 4	114 0	1 570
54 7	122 0	1 610
56 9	130 0	1 650
58 9	138 0	1 690
60 9	146 0	1 730
62 8	154 0	1 770
64 6	162 0	1 810
66 3	170 0	1 850
70	189 2	1 946
72	200 0	2 000
74	211 8	2 059

The amount of caustic soda to be dissolved in water to make a certain definite strength is rather a vexing problem, specially this is so when the caustic soda used is not cent per cent pure The following table, however, will be much helpful in this respect:—

TABLE OF SPECIFIC GRAVITIES OF SOLUTIONS OF CAUSTIC SODA.

Degrees Twaddle	Specific Gravity	Per cent by wt of Caustic Soda	lbs. of actual NaOH contained in 1 gall commercial caustic soda lye.		
			77°	74°	70°
1	1 005	0·474	0·048	0 046	0 043
2	1 010	0 757	0 098	0 092	0 087
3	1 015	1 436	0·146	0 131	0 129
4	1 020	1 909	0 194	0 185	0 180
5	1 025	2 365	0·234	0 231	0 219
6	1 030	2 830	0·291	0 278	0 262
7	1 035	3 252	0·335	0 320	0 303
8	1 040	3 746	0 389	0 371	0 350
9	1 045	4 184	0 438	0 417	0 393
10	1 050	4 631	0 486	0 461	0 438
11	1 055	5 086	0 536	0 510	0 483
12	1 060	5 536	0 586	0 558	0 528
13	1 065	5 982	0 636	0 607	0 573
14	1 070	6 413	0·680	0 653	0 617
15	1 075	6 911	0 742	0 707	0 668
16	1 080	7 285	0 786	0 749	0 709
17	1 085	7 715	0 836	0 798	0 755
18	1 090	8 140	0 886	0 845	0 800
19	1 095	8 564	0 937	0 894	0 846
20	1 100	8 970	0 986	0 941	0 890
21	1 105	9 386	1 037	0 989	0 938
22	1 110	9 796	1 087	1 037	0 981
23	1 115	10 203	1 137	1 123	1 026
24	1 120	10 607	1 187	1 175	1 071
25	1 125	11 107	1 238	1 181	1 117
26	1 130	11 471	1 296	1 237	1 170
27	1 135	11 933	1 354	1 292	1 212
28	1 140	12 401	1 413	1 350	1 277
29	1 145	12 844	1 470	1 413	1 337
30	1 150	13 303	1 529	1 460	1 381
31	1 155	13 859	1 600	1 528	1 445
32	1 160	14 190	1 646	1 541	1 496
33	1 165	14 637	1 705	1 627	1 539
34	1 170	15 081	1 764	1 684	1 593
35	1 175	15 512	1 822	1 739	1 649

Degrees Twaddle	Specific Gravity	Per cent by wt of Caustic Soda	lb of actual NaOH contained in 1 gall commercial caustic soda lye.		
			77°	74°	70°
36	1 180	16 139	1 904	1 817	1 719
37	1 185	16 372	1 942	1 853	1 753
38	1 190	16 794	1·998	1 887	1 804
39	1 195	17 203	2 055	1 963	1 856
40	1 200	17 629	2 122	2 026	1 916
41	1 205	18 133	2 185	2 085	1 973
42	1 210	18 618	2 252	2 147	2 033
43	1 215	19 121	2 323	2 221	2 097
44	1 220	19 613	2 392	2 280	2 161
45	1 225	19 997	2 444	2 338	2 206
46	1 230	20 586	2 562	2 417	2 285
47	1 235	20 996	2 593	2 475	2 341
48	1 240	21 532	2 669	2 548	2 410
49	1 245	22 008	2 739	2 615	2 474
50	1 250	22 476	2 809	2 681	2 536
51	1 255	22 961	2 881	2 750	2 602
52	1 260	23 433	2 952	2 818	2 666
53	1 265	23 901	3 020	2 886	2 730
54	1 270	24 376	3 095	2 955	2 795
55	1 275	24 858	3 175	3 027	2 863
56	1 280	25 295	3 237	3 090	2 932
57	1 285	25 750	3 308	3 158	2 988
58	1 290	26 210	3 381	3 227	3 053
59	1 295	26 658	3 452	3 364	3 117
60	1 300	27 110	3 524	3 394	3 182
61	1 305	27 611	3 603	3 439	3 253
62	1 310	28 105	3 682	3 514	3 324
63	1 315	28 595	3 760	3 593	3 395
64	1 320	29 161	3 849	3 674	3 475
65	1 325	29 574	3 919	3 742	3 539
66	1 330	30 058	3 997	3 816	3 610
67	1 335	30 535	4 072	3 891	3 681
68	1 340	31 018	4 156	3 967	3 754
69	1 345	31 490	4 232	4 042	3 824
70	1 350	31 948	4 312	4 116	3 894
71	1 355	32 446	4 396	4 196	3 970
72	1 360	32 930	4 478	4 274	4 043
73	1 365	33 415	4 561	4 354	4 109

Degrees Twaddle	Specific Gravity	Per cent by wt. of Caustic Soda	lb of actual NaOH contained in 1 gall. commercial caustic soda lye.		
			77°	74°	70°
74	1 370	33 905	4 645	4 434	4 194
75	1 375	34 382	4 728	4 513	4 263
76	1 380	34 885	4 810	4 592	4 344
77	1 385	35 328	4 893	4 670	4 418
78	1 390	35 795	4 975	4 794	4 493
79	1 395	36 258	5 058	4 828	4 567
80	1 400	36 720	5 141	4 907	4 642
81	1 405	37 203	5 227	4 989	4 720
82	1 410	37 674	5 312	5 071	4 797
83	1 415	38 146	5 397	5 135	4 873
84	1 420	38 610	5 482	5 233	4 950
85	1 425	39 071	5 567	5 314	5 027
86	1 430	39 530	5 653	5 396	5 104
87	1 435	39 986	5 738	5 467	5 181
88	1 440	40 435	5 823	5 558	5 258
89	1 445	40 882	5 908	5 640	5 335
90	1 450	41 335	5 923	5 721	5 412
91	1 455	41 875	6 093	5 816	5 502
92	1 460	42 400	6 191	5 909	5 608
93	1 465	42 935	6 290	6 004	5 679
94	1 470	43 467	6 389	6 090	5 769
95	1 475	43 980	6 487	6 193	5 856
96	1 480	44 505	6 586	6 287	5 948
97	1 485	45 013	6 685	6 381	6 035
98	1 490	45 530	6 784	6 476	6 126
99	1 495	46 041	6 884	6 571	6 216
100	1 500	46 545	6 982	6 665	6 303

An explanation of the table and the manner in which the table may be used by the manufacturers follow:—

(1) The first column indicates the degrees registered by the Twaddle hydrometer when it is immersed in a lye of caustic soda.

(2) The second column shows the specific gravity of the lye corresponding to any degree Twaddle For example, the figure in the second column against 36°Tw is found to be 1 180, this means that the specific gravity of the lye at 36°Tw is 1 180, or in other words the lye is 1 180 times heavier than its own volume of water

(3) The third column explains the amount of caustic soda present in 100 parts of the lye For example the figure in the third column against 36°Tw is 16 139, this means that when the density of a lye corresponds to 36°Tw, 100 parts of it contain 16 139 parts of caustic soda, both by weight

(4) The fourth column shows the number of lbs of caustic soda present in 1 gallon of the lye made with caustic soda of 77 degree strength In the case of the lye at 36°Tw, the corresponding figure in this column indicates that 1 gallon of this lye contains 1 904 lbs of caustic soda of 77 degree

(5) & (6) The fifth and sixth columns signify the same as above for lye made with caustic soda of 74 and 70 degrees, respectively

APPLICATIONS OF THE TABLE

The tables given above may be profitably utilised for the following purposes —

(1) The determination of weight of any given volume of lye or the calculation of the volume when the weight of the lye is known,

(2) Calculation of the proportions of water and caustic soda in making lyes of any desired strength

(3) Conversion of known volume of lye of one given strength into a lye of another given strength so that the lyes may be equivalent so far the soda contents of the two are concerned

(4) Determination of the exact proportions of water and caustic soda to be added in order to obtain a given weight of a lye of any particular strength

How the calculations are to be made are shown below —

CALCULATING THE WEIGHT

Suppose we have 5 3 gallons of lye at 36°Tw Consulting the table we find that the specific gravity corresponding to 36°Tw is 1 180 *i e* 1 gallon of the lye is 1 180 times heavier than 1 gallon of water But we know that 1 gallon of water weighs 10 lbs Therefore weight of one gallon of lye at 36°Tw is equal to 1 180 × 10 lbs of 11 80 lbs From this it follows that the weight of 5 3 gallons of lye at 36°Tw is 11 80 × 5 3 lbs or 62 54 lbs The working formula for the weight may be expressed thus —

Weight = No of gallons of the lye × specific gravity corresponding to the particular strength of the lye × 10 lbs

Hence in order to find out the volume of a lye when the weight is known, advantage may be taken of the formula in a modified form —

Volume of the lye in gallons = Weight of the lye in lbs divided by 10 times the corresponding specific gravity

MAKING A LYE OF ANY DESIRED STRENGTH

Suppose we want to prepare a lye at 36°Tw This can be done in a number of ways

The third column in the table gives the percentage of weight of pure caustic soda In other words the table gives the parts by weight of caustic soda contained in 100 parts by weight of the lye The figure in the third column against 36°Tw is 16 139 *i e* 100 parts of the lye contain 16 139 parts by weight of caustic soda the rest being water There fore water in the lye is (100—16 139) parts or 83 861 parts by weight Hence conclusion is made that 83 861 parts of water and 16 139 parts of pure caustic soda give a lye of 36°Tw from this by simple rule of three we can find out the amount of soda to be added to 100 seers of water which in the present instance comes to $\frac{16139 \times 100}{83861}$ seers

The working rule to prepare a lye of any particular degree Twaddle is

Add to 100 parts of water $\frac{\text{corresponding per-centage figure} \times 100}{100 - \text{corresponding percentage figure}}$ *parts of pure caustic soda*

On the other hand, the working rule in preparing a caustic lye of any particular degree Twaddle is

Add $\frac{100 - \text{percentage figure}}{\text{percentage figure}}$ *parts of water to one part of caustic soda*

To tackle the problem from another standpoint Suppose use has been made of 74 deggree caustic soda Consulting the table it is found that 1 gallon of lye at 36°Tw made with 74° caustic soda contains 1 817 lbs of actual soda Considering that 74° soda contains 95 48 per cent of caustic soda, 1 817 lbs of pure soda is contained in $\frac{1\,817 \times 100}{95\,48}$ lbs of caustic soda of 74° stuff Again the weight of 1 gallon of the lye is, as explained before, 10 × 1 180 lbs Deducting therefrom the weight of the caustic soda, the proportions of water and soda may be obtained The general rule is.

$10 \times s \times g - f \times 100$ lbs of water require $f \times 100$ lbs of caustic soda, where

s is the specific gravity corresponding to the degree Twaddle of the lye to be prepared,

f is the lb of actual soda contained in one gallon of the lye made with the particular grade of the soda used,

g is the percentage of pure soda contained in the soda used

CONVERTING ONE LYE INTO ANOTHER

Suppose we have a lye at 38°Tw near at hand whereas we would require, say, 5 gallons of lye at 36°Tw In that case the quantity of 38°Tw lye to be taken to be equivalent to 5 gallons of 36°Tw lye may be found out thus Suppose the soda used is of 77 grade

Consulting the table we find that when soda used is of 77 degree, 1 gallon of lye of 36°Tw contains 1 719 lbs and 5 gallons of the lye contain $5 \times 1\,719$ lbs Considering that I gallon of the lye at 38°Tw contain 1 804 lbs the number of gallons sufficient to hold $5 \times 1\,719$ lbs of caustic soda in solution is $\frac{5 \times 1719}{1804}$ gallons The general rule follows —

The Required Volume = Volume to be converted × lbs of actual soda corresponding to the hypothetical lye — lbs of actual soda corresponding to the lye ready at hand

CAUSTIC POTASH LYE

Caustic potash lye is made exactly in the same way as soda lye A table showing the relation between the specific gravities and the

percentage of potash with the corresponding weights of potash per gallon follows:—

Table of Strength of Caustic Potash Solution at 60°F.

Specific Gravity	Degrees Twaddle	Per Cent. KOH	lb of KOH Per gallon
1 060	12	5 59	0 59
1 110	22	11 31	1 25
1 150	30	15 48	1 77
1 190	38	19 29	2 21
1 230	46	23 22	2 84
1 280	56	27 87	3 56
1 330	66	31 32	4 16
1 360	72	35 01	4 76
1 390	78	38 59	5 36
1 420	84	40 97	5 81
1 440	88	43 83	6 31
1 470	94	47 16	6 93
1 520	104	51 09	7 76
1 600	112	55 62	8 89
1 680	136	60 98	10·24
1 780	156	67 65	12 04
1 880	176	75 74	14 23
2 000	200	86 22	17 24

MAKING SODA ASH SOLUTION

In making soda ash solution it is found that ten gallons of water dissolve 7.1 lbs. of pure sodium carbonate at 32°F, 12.6 lbs. at 50°F, 16 5 lbs at 59°F, 21 4 lbs. at 68°F, 38.1 lbs. at 86°F, 59 lbs. at 90.5°F, 46.2 lbs. at 93°—174°F and 45.1 lbs. at 212°F. The following table shows the specific gravities of soda crystal solutions of different strengths.

Table of Specific Gravity of Sodium Carbonate Solution at 15°C

Sp Gravity	Degrees Beaume	Degrees Twaddle	Per cent by weight	
			Na_2Co_3	Na_2Co_3, 10 H_2O
1 007	1	1 4	0 67	1 807
1 014	2	2 8	1 33	3 587
1 022	3	4 4	2 09	5 637
1 029	4	5 8	2 76	7 444
1 036	5	7 2	3 43	9 251
1 045	6	9 0	4 29	11 570
1 052	7	10 4	4 94	13 323
1 060	8	12 0	5 71	15 400
1 067	9	13 4	6 37	17 180
1 075	10	15 0	7 12	19 203
1 083	11	16 6	7 88	21 252
1 091	12	18 2	8 62	23 248
1 100	13	20 0	9 43	25 432
1 108	14	21 6	10 19	27 482
1 116	15	23 2	10 95	29 532
1 125	16	25 0	11 81	31 851
1 134	17	26 8	12 61	34 009
1 142	18	28 4	13 16	35 493
1 152	19	30 4	14 24	38 405

MAKING SALT SOLUTION

Though salt is added in powder to the soap stock for the separation of soap, it is sometimes added in solution form In making salt solution it will be found that a reddish froth is formed on the surface It should be skimmed off before use

At 15°C. water dissolves about 26⅓ per cent of common salt The following table gives the specific gravity of sodium chloride at 18°C

Table of Specific Gravity of Common Salt Solution at 15°C.

Specific Gravity	Degrees Twaddle	NaCl per cent
1 00725	1 6	1
1 01450	2 9	2
1 02174	4 3	3
1 02899	5 8	4
1 03624	7 2	5
1 04366	8 7	6
1 05108	10 2	7
1 05851	11 7	8
1 06593	13 2	9
1 07335	14 6	10
1 08097	16 2	11
1 08859	17 7	12
1 09622	19 2	13
1 10384	20 8	14
1 11146	22 3	15
1 11938	23 9	16
1 12730	25 4	17
1 13523	27 0	18
1 14315	28 6	19
1 15107	30 2	20
1 15931	31 8	21
1 16755	33 5	22
1 17580	35 1	23
1 18404	36 8	24
1 19228	38 4	25
1 20098	40·2	26
1 20433	40·8	26 395 Saturated

THE SOAP STOCK.

The lye being prepared of the density desired, the oil and tallow are to be taken in proper proportions to make a balanced soap stock. It is advisable to combine the hard soap producing and soft soap producing elements in proportions such that the colour, ap-

strength may vary from 25°Tw upwards Use of very strong alkali is to be avoided as that will render the product brittle Too much of the solution is also not to be added as that would lead to efflorescence on the soap The percentage should not be allowed to rise above 5

A slight addition of a weak solution of pearl ash 4°-8°Tw much improves the appear ance of the soap

Before adding sodium silicate it should be noted if the soap is alkaline or not This can be introduced when the soap is distinctly alkaline In the absence of it the resulting soap is liable to become like stone with age If the soap is acidic it is to be reduced first with dilute solution of silicate If the fatty acid be present to the extent of 3 to 4 per cent, a solution of 6°Tw is suitable while for a solution with 20 p c fatty acid a solution of 18°Tw would be necessary After this silicate of 140°Tw is added to the extent of 10 per cent of the soap produced

REMELTING.

Soaps are remelted when scents and other ingredients are to be added during the preparation of toilet soaps To remelt, the soap is just cut into thin shavings and then heated in a steam-jacketed pan provided with a number of upright steam pipes This device hastens the melting of soap, for soap being a

bad conductor of heat is hard to melt from below The time for melting is a greatly variable factor—the more the quantity of water present, the quicker it will melt

NEUTRALISING

To neutralise the free caustic alkali in soap various ingredients such as sodium bicarbonate, boric acid, coconut oil, stearic acid, etc should be added The best method is the addition of an exact quantity of sodium bicarbonate to neutralise the alkali

FRAMING.

The soap is generally allowed to cool in special frames The construction of the frames should be such as to conserve the heat as long as it is necessary for the soap A long narrow and high frame retains heat too long while in broad and low frames the soap cools down rather quickly For mottled soaps the frame should be of wood with a well in the middle for the accumulation of the lye

For framing fill up the frame with the soap and smooth the surface with a trowel leaving in the centre a heap which slopes towards the sides The next day the top of the soap is straightened with a wooden mallet. This assists consolidation The frame is left aside from 3 to 7 days for setting The unloose the screws, remove the side plates and bring out the block.

SLABBING AND BARRING

The block is then trimmed and scraped and is then to be slabbed and barred with special machines Soap bars are ordinarily made 15 inches long but bars have now mostly been antiquated The bars are generally cut into cakes having weights of 1 ch , 2 ch , 4 ch , etc

PILING

The soaps are then to be piled in such a way that the exposed surface is dried to form a new skin and is case hardened and thus prevents evaporation of water from within

Piling may be of two kinds, *open piling* and *close piling* When the soap is piled in a way that the air has free access it is *open piling* and when the soap is put in storage bins the operation is known as *close piling*

DRYING

The tallow soaps which are slabbed and barred while still warm are open piled immediately In the course of a day a skin is formed which prevents the evaporation of water from within But oil soaps do not develop this skin quickly These are exposed on racks to a current of hot air in a drying chamber On case hardening the bars are better adapted to be stamped If not properly dried, no gloss can appear on the soap which may partly adhere to the die

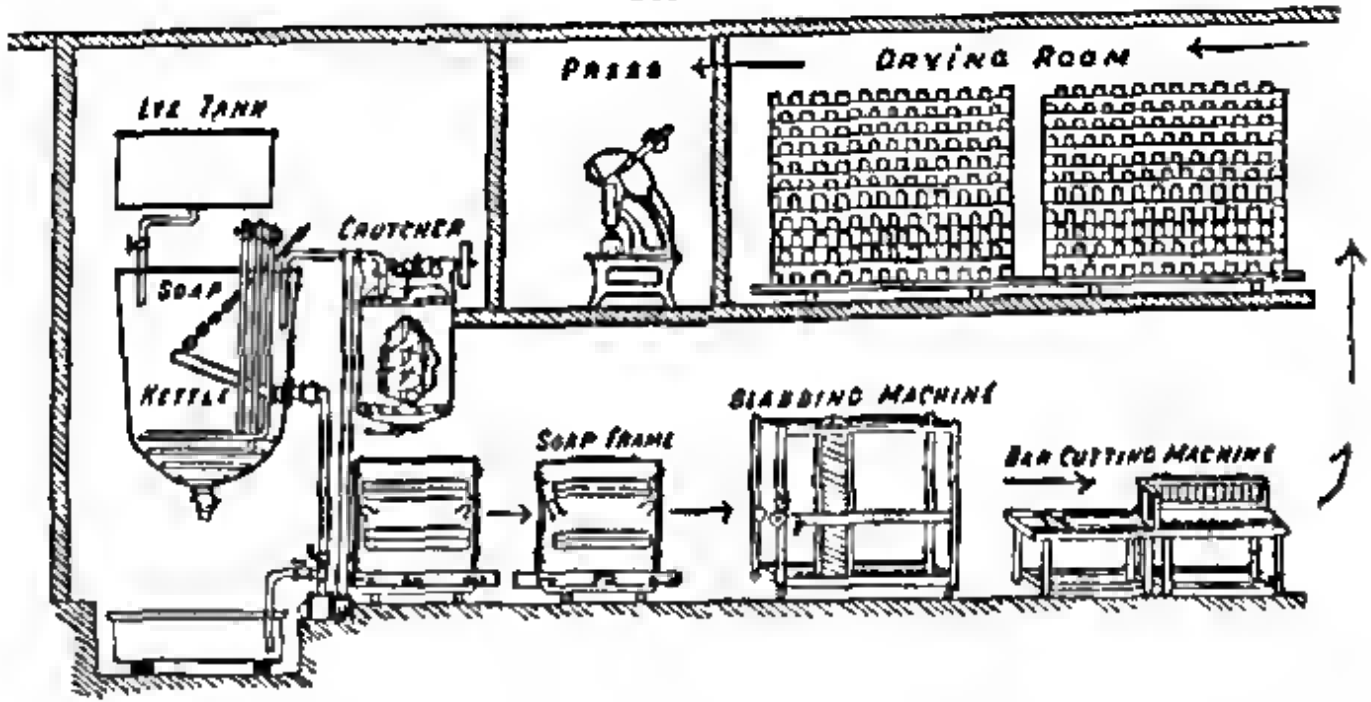
STAMPING

After being dried the pieces are ready to be stamped Use decent dies besmeared with a little oil or saline solution to prevent sticking in the die itself Finally put the soap on the racks and expose to the air for some time

For toilet soaps with concave faces it is usual to cut them into shapes to be finally given to the soaps The moulds may be either pin moulds and band or collar moulds In pin mould its edges meet very exactly the upper part of the die which carries two pins attached to the shoulder and these are received into two holes in the shoulder of the bottom plate This artifice helps towards getting symmetrical designs on either face The superfluous soap is forced out as the dies meet

Band or collar moulds prevent the squeezing out of soaps sideways The cake is put into the lower part of the mould and the upper plate which fits within the lower one is pressed on the soap block and gives it a well defined shape

Fig 13

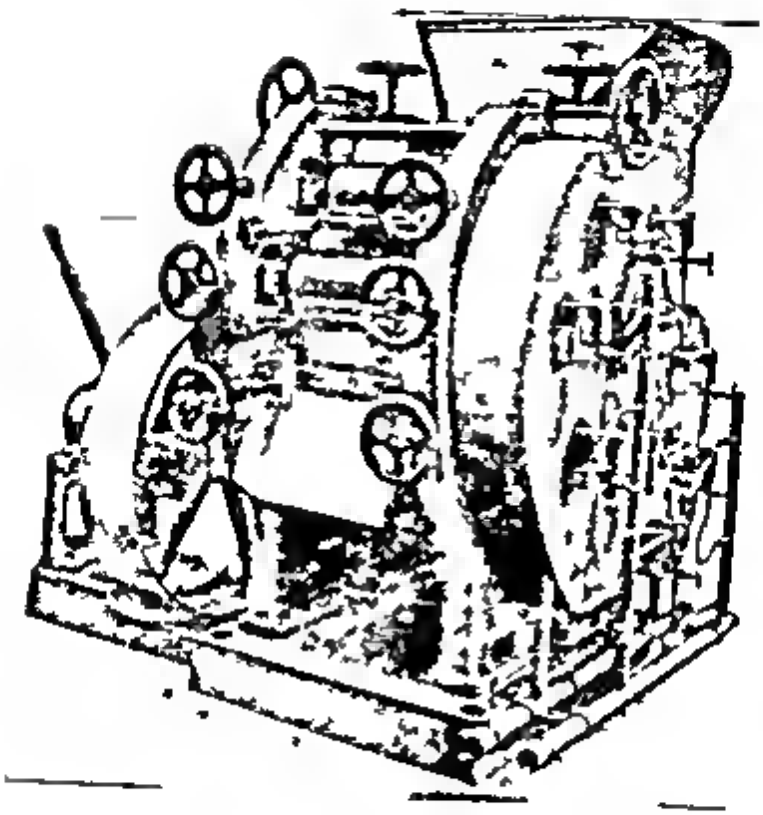


View of Washing Soap Factory

M. S.

[Ref page 115

FIG. 14



Multiple Soap Roller

M S

[Ref page 159

CHAPTER VI

WASHING SOAP.

THE starting point in the manufacture of soaps of all kinds is the selection of the soap stock Tallow and coconut oil can be used alone, mohua oil, groundnut oil, castor oil etc, are also used sometimes alone but more often than not they are blended with other oils to produce a balanced stock that would be cheap and at the same time yield a good soap

SOAP STOCKS

Recipes of a few soap stocks follow —

1 Tallow 20 seers, mohua oil 10 seers, groundnut oil 10 seers

2 Coconut oil 1 md, mohua oil 15 to 20 seers

3 Tallow 20 seers, groundnut 15 seers, mohua oil 5 seers

4 Mohua oil 1½ md, castor oil 10 seers, sesame oil 15 seers

5 Castor oil 1 md, sesame oil 10 to 20 seers

6 Mohua oil 1 md, sesame oil 10 to 20 seers

7 Tallow 2½ mds, cotton seed oil 1¼ mds, rayna oil 35 seers, rosin 8 seers

8 Tallow 45 seers, groundnut oil 15 seers, cotton seed oil 12 seers, rayna oil 25 seers, rosin 3 seers

9 Tallow 50 seers, karanja oil 25 seers, groundnut oil 22 seers, rosin 3 seers

10 Mohua oil 75 seers, coconut oil 10 seers, karanja oil 12 seers, rosin 3 seers

11 Mohua oil 1 maund and neem oil 1 maund.

12 Tallow 35 seers, groundnut oil 15 seers, mohua oil 15 seers and punnal oil 35 seers

13 Tallow 1½ mds, groundnut oil 30 seers, mohua oil 1 md, punnal oil 1¼ mds, and cotton seed oil ½ md

14 Groundnut oil 1 md, mohua oil 1 md, and punnal oil 1 md

15 Mohua oil 52 seers, refined punnal oil 45 seers, rosin 3 seers

16 Tallow 30 seers, mohua oil 30 seers, coconut oil 10 seers, karanja oil 20 seers, sesamum oil 7 seers, rosin 3 seers

17 Mohua oil 39 seers, coconut oil 12 seers, rosin 16 seers, nahor (mesua ferrea) oil 33 seers

18 Tallow 36 seers, coconut oil 15 seers, punnal oil 49 seers

19 Mohua oil 72 5 seers coconut oil 15 seers, rosin 4 seers, groundnut oil 8 5 seers

20 Tallow 43 5 seers, coconut oil 15 seers, rosin 2 seers, punnal oil 8 seers, groundnut oil 31 5 seers

CAUSTIC SODA

The quantity of caustic soda for the saponification of any soap stock can be found out from the saponification values already given of various fats and oils Suppose we take tallow 20 seers, mohua oil 10 seers and groundnut oil 10 seers Now the mean saponification values of tallow, mohua and groundnut oils are 13 8, 11 2 and 13 7 respectively, which means that

for 100 seers of tallow we require 13 8 seers of pure caustic soda for saponification,

for 100 seers of mohua oil we require 11 2 srs of pure caustic soda for saponification,

for 100 seers of groundnut oil we require 13 7 srs of pure caustic soda for saponification,

Hence for 20 seers of tallow we require $\frac{20 \times 13\,8}{100}$ or 2 76 seers of caustic soda,

for 10 srs of mohua oil we would require $\frac{10 \times 11\,2}{100}$ or 1 12 seers of caustic soda,

for 10 srs of groundnut oil we would require $\frac{10 \times 13\,7}{100}$ or 1 37 seers of caustic soda,

Hence the total quantity of caustic soda required is 2 76 seers + 1 12 seers + 1 37 seers = 5 25 seers

Usually this quantity is to be added in making soap by the cold process but when soap is made by the boiling process more than this is to be added, say $6\frac{1}{2}$ seers because

some part of the soda is used in bleaching and deodorising the stock as already mentioned When the oils used are not pure but are much adulterated, the saponification value is to be found out individually according to the process already given on *page 51*

SOAP BY COLD PROCESS

(For general method consult p 49 and 68)

I

Coconut oil	2½ mds
Caustic soda 77°	16½ seers
Water for Soda	33½ ,,
Silicate of soda	25 ,,
Water for Silicate	25 ,,

PROCEDURE —In the summer the coconut oil exists in the liquid state and need not be heated at all When the oil is frozen in winter, it is heated to 80° to 90°F to melt it Take 16½ seers of caustic soda 77° or cent per cent pure Dissolve in 33½ seers of water This will make a lye of about 38°Be Pour the lye into the melted fat or oil in a continuous stream, at the same time stir with a flat wooden stirrer about 3 ins broad Continue gentle stirring until the lye and fat are thoroughly combined and appear of the consistence of honey Do not stir too long, or the mixture will separate again The time required varies somewhat with the weather and the kind of oil used, from fifteen to twenty minutes is generally sufficient If silicate of soda

is to be added, this may be done at this stage 25 seers silicate dissolved in 25 seers of hot water may be stirred into When the mixing is completed, pour off the liquid soap into any sufficiently large square box for a mould, previously damping the sides with water so as to prevent the soap sticking Wrap up the box well with old blankets, or better still leave it in a warm place until the next day, when the box will contain a block of soap which can afterwards be slabbed and barred

If the soap turns out streaky or uneven, it has not been thoroughly mixed If very sharp to the taste, too much soda has been taken, if soft, mild, and greasy, too little In either case it must be thrown into a pan and brought to a boil with a little more water In the first case, boiling is all that is necessary, in the other a little more oil or a little more soda must be added

The finished soap will contain 25 per cent of water which is a general average If more water needs be retained in the soap use weaker lye and vice versa

If filling agents, colours and perfumes are to be added this should be done before framing by crutching

II

Tallow	100 lbs
Caustic soda 77°	15½ „
Water	34½ „

PROCEDURE.—Melt the tallow at 110° to 120°F If it is not clean or contain salt, it must be rendered or purified as directed on *page 84*, for the presence of salt would spoil the operation entirely by causing the lye to separate But if it be simply discoloured or even rancid, no such treatment is necessary Dissolve 15½ lbs of 77° caustic soda in 34½ lbs of water This will make a solution of 68°Tw strength Add the lye a little at a time and proceed as in (I)

III

Tallow	50	lbs
Coconut oil	50	,,
Caustic soda	16	,,
Water	34	,,

PROCEDURE —Melt the tallow and oil at 100°F Make a lye by dissolving 77° caustic soda in water It will be at 70°Tw Add the lye a little at a time and proceed as in (I)

IV

Stearic acid	2½	mds
Caustic soda	27½	seers
Water 1 md	32½	,,

PROCEDURE —Place the caustic lye in the crutcher Set the crutcher in motion and then add the melted stearine in rapid stream, so that the entire charge is poured in the course of two or three minutes A partial saponification takes place at once but the soap remains thin and with a slightly open appear

ance After 5 to 10 minutes, the soap thickens and looks close and smooth If any filling material is to be used, it should be added at this stage before the temperature attains 150° Fahr The length of time the soap should be crutched after thickening for having the filling agent well mixed, will depend upon the kind of soap desired Such other variable circumstances as speed of crutcher, etc , can be best determined by a few runs in each particular case As a general rule the soap should be dropped from 15 to 20 minutes after all the fatty acids have been introduced A jacketed crutcher should be used and the temperature of the lye and fatty acids as well as that of the finished soap, will depend upon the kind of soap being made, and can best be determined by a few runs in each case/ The suitable temperature will be 140° to 160° Fahr at which to drop the finished soap as a general rule This would require a somewhat lower temperature of the lye and stock before mixing

V

Tallow	30	lbs
Coconut oil	10	„
Caustic soda lye 36°Be	30	„
Silicate of soda 40°Be	50	,
Pearl ash lye 36°Be	8	„

PROCEDURE —Put the tallow and oil in an iron vessel and apply gentle heat so that its temperature does not rise above 150°F

When this temperature is reached, transfer the molten mass into frame, pour down the caustic soda lye as quickly as possible and at the same time the fatty matters are continually stirred until the soap begins to thicken up Now run in silicate and pearl ash with rapid stirring As soon as the mark made on the surface remains, stop stirring Cover the pot with gunny and under no circumstances it should be disturbed until the soap is cold It is then cut into bars and stamped

VI

Coconut oil	428 lbs
Tallow	433 lbs
Caustic soda lye (28° Be)	489 lbs
Sodium silicate	50 lbs

PROCEDURE —Same as above

VII

Mohua oil	17 parts
Coconut oil	3 „
Flour	6 „
Soapstone (powdered)	2 „
Silicate of soda	2 „
Caustic soda 70°	$4\frac{1}{8}$ „
Water	32 „

PROCEDURE —Melt and mix the oils together and add slowly to this mixture the caustic soda lye prepared previously by dissolving the caustic soda in 32 parts of water While adding the lye the oil is constantly

stirred until an emulsion is formed Then add the flour, soapstone and silicate of soda, and stir again until these are thoroughly incorporated When the whole mass gets thick, becomes perfectly uniform and translucent and when a sample taken out with the trowel and cooled can be drawn into threads, the soap is run into frames

VIII

Tallow	31	lbs
Coconut oil	6	,,
Rosin	19	,,
Caustic soda lye (33°Be)	32	,,
Sodium carbonate solution (35°Be)	8	,

PROCEDURE —The tallow is first melted and then the coconut oil Next the rosin is introduced When melted well together the mixture is allowed to cool down to 130°F, the lye is then added and the soap allowed to stand for about 2 hours When the soap is finished the sodium carbonate solution is added and the whole mass crutched well Now frame and cool

IX

Coconut oil	16	lbs
Castor oil	4	,
Rosin	20	,,
Caustic soda lye 35°Be	24	
Caustic potash lye 30°Be	¾	lb

PROCEDURE —Melt together coconut oil 16 lbs, castor oil 4 lbs rosin 20 lbs, and compound the mixture at a temperature of 155°F with 24 lbs of soda lye of 35°Be. In case a thorough combination is not formed, cover the mixing vessel with cloths and the mixture will in a short time become hot When this is the case, stir it thoroughly and when it appears to be intimately combined, stir in ¾ lb of solution of caustic potash of 30°Be and then pour the paste which should be uniform and thick, into frames

X.

Coconut oil	1½ mds
Sesamum oil	1 md
Caustic soda	16½ seers
Water	33½ „

PROCEDURE —Melt the coconut oil, if necessary and mix with this the sesamum oil Now prepare a lye by dissolving 16½ seers of caustic soda in 33½ seers of water This will make the solution of a strength of 38°Be Heat the oils slightly and pour in the lye gradually with stirring When the saponifica tion begins put in frames and allow to cool

XI

Coconut oil	2¼ mds
Groundnut oil	10 seers
Caustic soda	16½ „
Water for soda	33½ „

Silicate of soda	30	seers
Water for silicate	30	„

PROCEDURE —For adding sodium silicate refer to *page 68* and proceed as in I

XII

Coconut oil	1	md
Sesamum oil	1	„
Caustic soda	12 seers 2	ch
Water for soda	28	seers
Silicate of soda	20	„
Water for silicate	20	„

PROCEDURE —Dissolve the caustic soda in water This will give a strength equal to 36°Be Then heat the oil as before and add the lye When the lye and the oil are mixed, add the silicate according to the method given on *page 68*, stir vigorously and frame

XIII

Coconut oil	2	mds
Groundnut oil	20	seers
Caustic soda	$15\frac{1}{8}$	„
Water for soda	$34\frac{7}{8}$	„
Silicate of soda	30	„
Water for silicate	30	„
Soap stone	$12\frac{1}{2}$	„

PROCEDURE —Proceed as in XI Mix the soap stone in the frame and crutch well

XIV

Coconut oil	16	seers
Mohua oil	12	„

Castor oil	2½ seers
Caustic soda lye 37½° Be	15 „
Water	5 „

PROCEDURE —Heat the oils in an iron soap vessel to a point when it produces smart cracking sounds when a few drops of water are put in or a little sprinkling of water produces foam Now mix the lye slowly and stir it thoroughly Put out the fire If the oils were properly heated the mixture will boil in a few minutes When it calms down, add to it 5 seers of water and stir it thoroughly It will remove all defects from the soap To impart a pale yellowish tint like that of sun light soap incorporate a trace of brown colour into the oil before the addition of the lye

SOAP BY SEMI BOILING PROCESS

(*For general method consult p 54 and 68*)

I

Coconut oil		2½ mds
Caustic soda	20 seers	10 ch
Water		2 mds

PROCEDURE —Prepare the lye which will be at 27°Be Mix the oil and the lye together, put in an iron pan, and apply heat Continually stir for 1 or 2 hrs, when the paste will gradually thicken Slow down the heat at this stage but continue stirring After a time the paste will turn into a white semi solid mass, which forms the soap Fill the mass imme

diately into the frames Silicate may be introduced as explaintd on *page 68*

II.

Tallow	100	lbs
Caustic soda lye (10°Be)	8	gallons
Caustic soda lye (15°Be)	4	„
Caustic soda lye (20°Be)	6¼	„

PROCEDURE —Melt the tallow with a slow heat Now add 8 gallons of caustic soda lye at 10°Be and stir well still keeping on gentle fire for 4 or 5 hours When the fact is emulsified, add gradually 4 gallons of lye at 15°Be After this the whole contents will form a pasty mass In order to prevent jamming and break the clotting, add 6¼ gallons of lye at 20°Be Go on boiling until the whole of the tallow is saponified Add water to the soap as the lye gets stronger with evaporation of water

III

Coconut oil	20	seers
Mohua oil	10	„
Groundnut oil	10	„
Caustic soda	8	„
Water	30	„

PROCEDURE —Proceed as above

IV.

Mohua oil	1	md.
Wheat flour	1	„
Caustic soda	9	srs
Water	21	„

Powdered salt	15 seers
Soda ash	15 „

PROCEDURE —Prepare 30 seers of the lye, which should be of 36°Be strength Heat the oil in the iron pan When a cracking sound is perceived on addition of a few drops of water pour down 20 seers of lye The fire is then withdrawn and when the mass gives out no more vapour pour down 4½ mds of water and again boil for two hours When the soap thickens remove the fire Now mix intimately the flour salt, and soda ash which should be powdered and sprinkle the mixture on the soap mass and stir Finally add the remaining lye and again stir Then frame

V

Mohua oil	27 seers
Sesamum oil	12 „
Caustic soda	7¼ „
Water for soda	1 md
Silicate of soda	10 seers
Water for silicate	10 „

PROCEDURE —Proceed as above When the saponification is complete add the hot silicate solution (*p* 68) to the hot soap stock and mix vigorously Finally put into frames

VI

Coconut oil	1 md
Groundnut oil	5 seers
Caustic soda	8 „

Water for soda	1	md
Silicate of soda	12	seers
Water for silicate	12	,,

PROCEDURE.—As above

VII

Coconut oil	16	seers
Sesamum oil	20	,,
Caustic soda	7	,,
Water for soda	1	md
Silicate of soda	5	seers
Water for silicate	5	,,

PROCEDURE —Same as above

VIII

Sesamum oil	20	seers
Groundnut oil	50	,,
Caustic soda	10	,,
Water for soda	1¾	md
Silicate of soda	10	seers
Water for silicate	10	,,

PROCEDURE —Same as above

IX

Mohua oil	1	md
Groundnut oil	30	seers
Castor oil	15	,,
Sesame oil	15	,,
Caustic soda	14	,,
Water to dissolve	36	,,
Salt	10	,,
Soda ash	10	,,
Wheat Flour	20	,,
Water	1½	md

PROCEDURE —The oils are mixed together and heated in a pan till the oils begin to give off vapour The oils need not be made to boil Now pour in the lye made by dissolving the caustic soda in water and stop heating When the soap stock is warm add water and heat again for half an hour Stop heating and add powdered salt soda ash and wheat flour after mixing them intimately and sifting them through a fine sieve Stir well all the while so that no lumps form in the body of the soap Finally frame

X

Castor oil	1	maund
Sesame oil	4	seers
Water	16	"
Soda Chloride	1	seer
Caustic lye (38°B)	24	seers

PROCEDURE —Mix water and lye and let the mixture stand for a time Now place the oils on fire When the mass becomes homoge neous add a solution of Sodium Chloride and again boil When it has been sufficiently boiled test it by dropping on the ground If the drop becomes thoroughly dry it is ready for being poured into frames When this is sufficiently boiled test it by dropping on the ground If the drop becomes thoroughly dry it is ready for being poured into frames This is a suffi ciently hard specimen of soap It lathers well and also washes well

SOAP BY BOILING PROCESS

(*For general method consult p 55*)

I

Tallow	20	seers
Mohua oil	10	,,
Groundnut oil	10	,,
Caustic soda	8	,,
Salt	5	,,

PROCEDURE —The oil is saponified with the caustic soda as shown on *p 55* & *58* Now salt out (*p 58*) with the addition of salt and allow to settle The salted soap is then taken out or the waste lye is withdrawn Now melt the soap with the smallest quantity of water to hold it in solution and heat gently When much froth appears on the soap, frame and allow to cool Finally trim

II

Any soap stock (*p 115*)	1 md
Caustic soda	Calculated as shown on *p 117*
Filling agents (*p 36*)	as desired

PROCEDURE —Proceed as above and introduce the filling agents before framing and crutch well to have all the ingredients well mixed For incorporating filling agents see *pages 69 70* and *110* The soap should be distinctly alkaline when silicate of soda is used

III

Neem oil*	1 md
Caustic soda	7½ srs
Salt	q s

PROCEDURE —Take the raw oil in a pan On the addition of the caustic alkali to the *neem* oil a greyish yellow emulsion is formed which gradually becomes clearer as the saponification proceeds Finally, a clear, yellow soap is produced During the boiling much odour is given off The longer the boil, the more the removal of odour by the steam The soap solution should not be concentrated but be allowed to remain thin at the conclusion of saponification Salt should now be thrown into the pan and the contents boiled gently until the soap shows clear signs of breaking, which is the most favourable condition for the elimination of the colouring matter The spent lye will have a large volume, a strong smell and a dark brown colour—facts which show that a large quantity of the colouring matter as well as odour, has been taken up by the lye A further removal of colour from the soap is effected by giving it a second brine wash as described above The washed soap will have a pale yellow colour, characteristic

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*Special precautions are to be taken when neem and punnal oils are used in making wash ng soaps The process given here is suggested by the Industrial Chemist Department of Industries Bengal in Bulletins No 47 and 43

of many varieties of washing soap and be free from any strong odour

In order to carry out the saponification and salting of *neem* oil it is, however, not always necessary that fresh caustic lye only should be used The spent lye of a previous soap charge, unless very deeply coloured, can very well be used for bringing about the saponification of the oil The spent lye usually contains some unused alkali The oil is poured into the lye in quantities which can be saponified by the free alkali present in the latter The oil floats on the top and, as the boiling proceeds, small quantities of it become saponified By the time the soap produced floats on the top in a granular form and having a yellowish colour, while the bulk of the colouring matter goes to the lye which becomes deeply coloured After allowing some time for the settling of the lye, the latter is removed, and the soap is boiled again with another instalment of a light coloured spent lye which, in its turn takes up some of the colour still remaining in the soap but does not itself become as deeply coloured in the process as the earlier lye and may be preserved for use in the initial saponification of a fresh quantity of the oil The second saponifying process leaves the grains of soap with only a pale yellow colour and a faint odour, and fit to be mixed with the other stocks for the production of the soap for the market

The process of purification of over spent caustic lye brings about a saving of cost under caustic soda and salt, inasmuch as the said ingredients necessary for saponification and graining are recovered from the spent lye which in many small factories is simply thrown away

It has also been found that a further removal of the traces of odour persisting in the soap made from this oil according to the method described above is effected by allowing the soap in granular form to remain exposed to the atmosphere for a few days or simply putting the same away in a heap for use after a few weeks

POT MOULDED SOAP

The following processes of making pot moulded soaps and framing and stamping of grained soaps are taken from Bulletins issued by Industrial Chemist Department of Industries Bengal

Coconut oil	20	seers
Mohua oil	10	,,
Groundnut oil	10	,,
Caustic soda	8	,,
Salt	5	,,

PROCEDURE —The oil is saponified as already noted (*p* 55) and grained or salted out (*p* 58) The salting process for moulded soap is very exacting The salted soap should not contain any air bubbles, and the soap is re

quired to be separated in the form of air-free big grains of the size of peas For this purpose, the soap, as salted before, is boiled gently with the formation of visible convection currents of froth without the appearance of big bubbles A very low fire is needed for this As the boiling is continued, the froth decreases and the soap forms into definite grains which gradually increase in size The process is complete when the soap is free from froth, and it forms into definite grains This stage is usually attained in about 2 to 3 hours' time The soap is transferred with a perforated ladle to another pan, kept hot by a jacket in which water is boiled The object of this is to keep the soap grains hot and plastic till the moulding is complete During the transference of the soap from the boiling pan it will be found that some amount of lye is carried over mechanically In the water jacketed pan the soap is rapidly worked by a trowel to break the grains, and quickly moulded into pots, which can be made of any shape to suit the requirements of the trade The small amount of lye carried mechanically gradually subsides at the bottom and sides, and is occasionally removed by means of a ladle After the mould is filled with soap the top of it is usually pressed with a coarse cloth to give a smooth surface The moulded soap in the pots is allowed to stand for a few days to set properly, after which the soap is removed from the mould by a little

pressure of the hand applied on one side. The soap may finally be polished with a knife and sent to the market

In making moulded soap, the worker has to stand by the side of the pan containing the grained soap and bend over its edge to work up the soap with a hand trowel and remove it for moulding in earthenware cups or for cooling frames It may be seen that for the carrying out of this operation the pan must be of such a size that all the removable soap can be reached and worked by the worker with his hand Experience shows that a 38 deep pan with a proportionate diameter and having a somewhat straight side is about the maximum size that can be used for the above purpose, and as only a few inches of soap are formed in a pan of this size, the output of soap per pan cannot be much This is a serious drawback for factories requiring a high output as they have at present no alternative other than the multiplication of units which takes up considerable factory space and requires the employment of a large number of operatives Further it entails considerable cost on fuel for the small direct fired pans are notorious for their excessive fuel consumption These factors necessarily increase the cost of production to a great extent These drawbacks can be rectified by following improved methods detailed on *p 141*

PUNNAL SOAP

Punnal oil	40 seers
Caustic soda	7½ „

PROCEDURE —Proceed with the oil as described on *p* 55 The first addition of alkali produces a deep yellow colour and the original greenish colour of the oil disappears with the boiling of the mixture As the saponification proceeds the colour of the solution gradually changes from deep yellow to dark brown with a cloudiness On the completion of saponification the cloudiness disappears and a clear soap of a dark brown colour is obtained After the addition of salt the graining of the soap proceeds normally through, at times the soap shows a tendency to become much frothy The froth gradually becomes less and less but a little of it persists at the top even after the completion of the graining The thin layer of froth is then gathered in one side of the pan by a trowel leaving bare the neat soap This soap is taken out by means of the trowel and put in earthenware cups which are used as moulds The soap solidifying in the cups has a somewhat soft consistency and a dark brown colour in spite of the fact that a considerable quantity of the colouring matter is eliminated in the spent lye

GRAINED OR DHOBI SOAP

In making grained or dhobi soap the saponification is conducted in exactly the same

way as in the existing process (*p* 55) On the completion of saponification common salt is thrown into the pan and the contents thereof are kept at a gentle boil The soap gradually separates from the lye and takes a granular form The graining is accompanied by progressive dehydration of the soap, and, in order to be successful, should proceed slowly The gentle boil should be continued so long as the soap grains do not become too hard to be worked up by the trowel into a soft mass like fluid clay When this limiting stage is reached the soap is ready to be transferred into the frame. The superficial froth should disappear by this time, but if it does not, the boiling cannot safely be continued on that account. For on continuing the boiling until the disappearance of the froth in such a case the soap grains may become too hard to impart compactness to the soap in the frame. In cases where the soap is desired to be framed in a highly concentrated form the operation of dehydration by boiling may be continued for some time more

On the conclusion of graining the pan is allowed to rest for some time to allow of the settling of the spent lye The period of rest varies from twenty minutes to one hour according to the size of the charge If allowed too long a rest, a portion of the soap solidifies and cannot be worked up into coherent soap for transferring to the frame.

After allowing due rest the superficial froth, if any, is removed from a portion of the pan and the grained soap is worked rapidly by means of a trowel so as to break the soap grains into a viscous clay like mass, care being taken at the same time not to disturb the lye underneath The worked up soap is then quickly transferred into the soap frame It is essential that the grain breaking and transferring should be done quickly, and for this purpose there should be sufficient number of hands to deal with the soap charge in the pan in a short time The yield of soap per boil depends on the quantity of soap successfully transferred from the pan into the frame As much soap as possible should, therefore, be taken out of the pan without of course, allowing it to be contaminated with the lye

Framing

To remove a comparatively large portion of the soap without allowing the same to harden up or enclose lye, hollow tins, with weights placed inside, are lowered into the soap in the pan in regions away from the workers until the tins float on the lye The soap displaced by the tins moves on towards the region of work and increases the thickness of the soap layer there In this way a very large portion of the soap can be put into the frame directly from the soap pan Wooden blocks of sufficient weight may also be used to displace the soap for the above purpose

The frames used need not be very large These may have a size of say, 17″ high, 24″ long and 12″ wide or even 22″ high, 24″ long and 12″ wide, or any similar dimensions The top of the soap mass in the frame after filling up should be levelled with the trowel before setting aside to cool

The cooling and setting of soap in the frame requires from 3 to 4 days depending upon the degree of dehydration of the soap in course of graining the size of the frame, and, finally, the season The block of soap obtained on removing the sides of the frame is found to be neat and compact and capable of being slabbed, barred and cut into pieces by means of the usual slabbing, barring and piece cutting apparatus The slow cooling of the soap in the frame usually secures for the soap a fine coherent body which cannot be attained in pot moulded soap which cools down in a few minutes If a still better appearance and concentration of the soap is desired the end can be achieved by double salting which improves the body and texture, lessens dullness, and brings about further improvement in the colour of the soap In the case of double salting however, the first graining should be stopped as soon as the soap clearly separates from the lye

Stamping

The pieces cut in the usual way can be stamped after drying in the air for a day or

two If, however, it is desired to stamp the pieces on the same day that they are cut, a superficial drying at 60°C for half an hour to an hour and a half will help to develop good gloss and correct impression The stamping is best done for factories of moderate output, by means of a foot operated pendulum press While at work the dies of the stamping press should be sponged or wiped from time to time with the spent lye or a solution of common salt and glycerine in water

IMPROVED METHOD OF MAKING GRAINED SOAP

The following method of making grained soap is recommended in Bulletin No 52 published by Department of Industry, Bengal

In this process the saponification and the graining are done in the same pan

The use of a large steam heated pan in the place of a number of direct fired pans of a small size is recommended This results in saving in fuel and labour and ensures a better product, for the considerable darkening of colour of the soap caused by strong and unequal heating in direct fired pans is altogether got rid of

The pan is made of sheet iron the diameter of which is one and a half times the depth The pan should be slightly rounded at the bottom, the entire bed of which should be covered with the indirect steam coil At the centre of the bottom there should be a short

direct steam coil with perforations on all sides In this pan both the direct and the indirect steam can be used during the saponification, while during the graining the direct steam alone It can be made as large as those in use in the biggest soap factories for the making of fitted soap

The saponification of oils and fats is carried out according to the standard method of soap manufacture After the graining operation the soap is transferred over channels assisted by gravity or pumped into a crutching pan which consists of a deep round bottomed cylindrical tank of sheet iron having an outlet at the bottom large enough to empty it quickly and provided with a mechanical stirring or crutching gear For facility of work the crutching pan shall be placed at some height from the floor so that the crutched soap can be quickly discharged into the frames placed underneath without any intermediate cooling taking place The size of the crutching pan shall be such as to be able to take the entire charge of grained soap of the original pan As the saponification and graining may take more than two days a single crutching pan will suffice to handle the output of two or more regular saponification and graining pans After transference, the soap in the crutching pan is allowed to stand preferably overnight to effect a proper settling of the lye The separated lye is next drawn off,

leaving only the neat soap in the pan The crutching gear is now put into operation and the soap crutched for 10 to 15 minutes, depending on the character of the soap, until a homogeneous soap mass is obtained The soap is thereafter run directly into frames placed below the outlet In the frame a slow rate of cooling is necessary for a further dis engagement of the lye before the setting of the soap takes place The more thorough the elimination of the lye the lower the salt content and the better the body of the soap The frames may be large or small The large ones may be made of iron as the soap in a large mass takes a long time to cool The small frames however, shall be made of wood

PALE SOAPS

Bar soaps are good detergents, though not suitable for washing lace and delicate white fabrics, on account of the liability to stain, due to the presence of much rosin These soaps owe their colour and characteristic odour to the rosin they contain, though a small amount of artificial colouring matter is sometimes added The best types are made from tallow with an admixture of from 15 to 25 per cent rosin A lower grade bar soap, containing 62 to 64 per cent of fatty acids is made from tallow or bone fat, with pressed coconut oil, cotton seed oil, or cotton soap and a darker rosin, the unbleached cotton seed oil imparting

a brown colour to the soap The proportion of rosin to be added depends upon the firmness of the other materials employed If much cotton seed oil is used, it will not be possible to add any considerable quantity of rosin without injuring the body of the resulting soap In the case of genuine soap, though this defect can be rectified by crutching in sodium carbonate or silicate, it is generally advisable to use firmer stock with less rosin For a brown soap, a fairly dark coloured rosin may be used

Cheaper bar soaps are also made They are not, however, pure soaps, the proportion of fatty acids in them falling to 50 per cent or even less These are prepared by 'liquoring' or 'running' soaps as described on *page 110* but more coarsely fitted (*page 61*) by admixing in the crutching pan solutions of sodium carbonate, silicate, chloride or sulphate The two former have distinct detergent qualities and their addition to soap is often justified on this ground They also very much reduce the cost of a soap owing to their hardening property which permits of the use of a large proportion of oil or rosin in the stock or of a greatly increased percentage of water in the finished soap

Method of Using Rosin

Rosin is a good cheapening agent for pale soaps owing to its forming a soap having good detergent properties When using rosin it is a good plan to saponify it separately and then

add it to the soap made from the oils Sometimes soda is employed to convert the rosin to soap, in which case the rosin is melted over water in a steam jacketed pan, while in another pan ordinary soda crystals are dissolved in a small quantity of water The proportions are 17 2 lbs of soda crystals to 112 lbs of rosin The soda liquor is added to the rosin in small quantities at a time waiting until effervescence ceases before adding a succeeding quantity of soda After all is added the soap is boiled for a short time to finish the saponification Then the soap is run into the pan of rosin soap

The rosin of the usual grades produces darkish coloured soap An improvement may, however, be effected by adopting the following method of purification The rosin is saponified by soda as described above, the rosin soap is salted out by the addition of ordinary salt and time is allowed for the soap to settle Then the lye is run off carrying with it a large proportion of the colouring matter of the rosin The rosin soap thus purified may be added to the soap to which rosin is to be mixed The soap is finally saponified with caustic soda lye, or as is more generally adopted as a rosin charge The pan is opened with caustic soda lye and saturation of the rosin takes place rapidly, when completely saponified it is grained with salt, and the coloured lye is allowed to deposit and finally withdrawn Then crutch and put into frames

Rosin soap is generally of a soft consistency Hence to compensate it some sodium silicate or soap stone is incorporated in the mass This hardens the soap and brings it to the proper consistency

I

Tallow	1 md
Rosin	24 srs
Caustic soda	9¾ srs
Water	22¼ srs

PROCEDURE —The tallow is saponified according to the general process of soap boiling and is salted out (*p 58*) The spent lye is run off Rosin is now added with fresh alkali and the whole is boiled till the rosin is saponified This is known as rosin boiling Now salt out again and allow the dark waste lye to settle for a long time and withdraw it carefully The soap is then framed slabbed and barred

II

Tallow	1 md
Rosin	24 srs
Sodium silicate	10 srs
Caustic soda	10¼ srs
Water	23¾ srs

PROCEDURE —First melt the rosin with all or part of the fat in an iron pan over moderate fire When the mixture is at 150°F add the lye made with caustic soda and water which should be of 36°Be and stir continuously

Arrange the fire so that the temperature remains steady thereabout After the mass has been mixed for half an hour, the soap will at first thicken, then grain and it may again become thick before it becomes smooth When the mass is perfectly smooth and homogeneous drop into a frame and crutch in the frame by hand to prevent streaking After standing for the required length of time the soaps may be moulded or stamped as desired

III

Tallow	2½ mds
Coconut oil	12 seers
Rosin	14 "
Caustic soda	17 "
Water	2 mds 4 "

PROCEDURE —Prepare the lye with soda and water The solution would register 23°Be Heat the tallow and oil in an iron pan and gradually run in caustic soda lye, till the goods have lost their greasiness and form into scales when pressed between finger and thumb When this is the condition remove from fire and gradually add salt to grain the goods (*p 58*) Let it rest for three or four hours Now run off the spent lye through the valve at the bottom of the pan Next the pan is again heated and the rosin broken up into small lumps is added Now gradually pour caustic soda till the rosin is saponified Boil well together for about two hours Salt out again as before, till the half spent lye is quite

clear, when put aside to cool Let it rest for 24 hours, when the whole will separate out in four layers

(1) A layer of light frothy soap on the top
(2) Good soap
(3) Curdy soap called niger
(4) Spent lye

The frothy soap is collected and boiled with the next batch The niger is also reserved for subsequent treatment The good soap is taken out and is again boiled with a little caustic soda lye of 28°Tw for about 2 hours, then framed and cut into blocks

The oils may be saponified together with the rosin but in that case the spent lye after the first salting runs to waste

IV

Coconut oil	20	seers
Cotton seed oil	5	,,
Rosin	7½	,,

PROCEDURE —Proceed as above

V

Raw tallow	60	seers
Mohua oil	30	,,
Punnal oil	10	,,
Caustic soda lye 36°Be	60	,,

PROCEDURE —Put the tallow in a suitable pan and heat so as to melt it Then remove the fire and slowly add half of the lye with continuous stirring Then boil until saponified This boiling goes on for 2 full days in the

course of which the other oils are added and more of the caustic soda lye Sufficiently more caustic soda lye is taken which settles at the bottom when the boiling is finished Soap is allowed to rest overnight and the upper layer is removed to another pan next morning where it is paddled and dried and cut into bars

VI

Tallow	50	seers
Groundnut oil	20	,,
Rosin	30	,,
Caustic soda lye of 36°Be	50	,

PROCEDURE —Saponify rosin with 10 seers caustic soda and 10 seers extra water When saponification is complete add the other oils and the rest of caustic soda and boil after boiling method When complete saponification is assured the soap is transferred into the crutching pan and mixed with sufficient water, to suitable consistency

This bar soap may be cheapened by the addition of silicate which may be stirred in the boiled soap after the emulsion is complete Sometimes, silicate settle below being heavier, care should be taken to stir the silicate till the whole soap becomes perfectly cool and thick If treated with silicate the silicate should be mixed with 10% caustic soda lye extra and added to the soap Soap stone powder or china clay may also be added in the soap but in that case, the soap will be heavy and opaque

TREATMENT OF WASTE SOAP

When charges of soap are spoiled on account of an addition of excess of salt or of too little of it or due to defective saponification, etc, the spoiled charges are to be first salted out These are next dissolved in water, the end of the saponification is tested (*p* 56) and the soap is grained out by the addition of just sufficient amount of salt

To recover soap from the dirty and waste soap of the factory the stock is first dissolved in water, and solid impurities are removed by a ladle The soap is then concentrated and salted when it separates at the top leaving all the dirt and lye at the bottom If the separated soap is not pure enough it is salted again when soap of good quality is obtained This recovered soap can either be added to new charges of fats and oils to be saponified, or dissolved along with salted soaps to form frame soaps

TREATMENT OF NIGER

The niger soap obtained from the settling process is of variable quality according to the quality of the raw materials If it be white-coloured it may be transferred to the boiling pan where more lye is added After boiling, the soap is salted out as before The best part of the soap may be moulded and framed and the other portions may be used with the next batch Niger soaps of dark colour can only be re used in making brown soaps

RECTIFYING SOAP BATCH

When boiling of soap is done imperfectly, there are signs of the soap getting viscous or the lye separating out from the soap which tends to become grainy

Viscosity of soap is mainly due to the presence of unsaponified fat or rosin in the body of the soap In such cases addition of a little lye will rectify this defect In cases where an excessive amount of lye has been added the soap can be rendered neutral by addition of a quantity of coconut oil

In cases where lyes separate out it is mostly due to the lye getting extra strong In such cases either the lye is to be diluted with water or absorbed by incorporation of some substance like flour and starch or neutralised with further addition of oil or some acid

PACKING

The soaps are packed in wooden boxes for distribution Superior soaps are however wrapped up in paper and put in cardboard cartons prior to being packed

CHAPTER VII

TOILET SOAP.

TOILET soaps demand the greatest attention from the manufacturers Besides possessing delicate colour compact appearance and delightful scent they should have detergent and lathering properties and should be absolutely free from the presence of any unneutralised alkali which will evidently cause an irritating sensation on the skin

The starting point in toilet soap manufacture is to make the soap according to the cold or the hot process as already detailed and then to incorporate suitable perfumes It needs no mention that the basis must be of the finest quality if the finished product is to be of superior grade

The toilet soap can ordinarily be made by three processes *viz* by cold process by remelting and by milling

TOILET SOAP BY COLD PROCESS

When the toilet soap is to be made by the cold process proceed exactly as shown on *pages 49 54* and *page 118* taking care to use the finest fats and oils See that the amount of caustic soda added is just sufficient to neutralise the oils and fats If the soap is alkaline, the perfumes when added may be ad

versely acted upon by the free alkali and the whole effect may be lost But there are certain perfumes (*p 39*) which are not so affected and their use is generally recommended

When the soap is ready to be framed instead of transferring into the frame put into a crutcher or soap mixer (*p 80*) A small quantity of coconut oil is added to neutralise any alkali which may be present in the soap

By adding a few drops of an essential oil when the mixing is complete, a toilet soap is produced When made with clean light-coloured oil, the soap produced is quite white

Any of the colours such as cadmium yellow vermilion, ultramarine, umbers, chrome green, chlorophyll, ochres, etc, are first added to the soap stock and crutched well If coal tar colours are to be added these should be previously dissolved in boiling water or spirit as the case may be Usually ½ lb of the mineral colour will be sufficient for colouring 1 cwt of the soap But for coal tar colours no definite rules can be given For 1 cwt of the soap, use 1 oz of Fluorescein Yellow Soap Yellow or Metanil Yellow dissolved in 5 oz boiling water, 1½ oz of Brilliant Rose or Rhodamine dissolved in ½ pint of water, 2 oz of Fast Light Green or Brilliant Orange or Methylene Blue dissolved in ½ pint boiling water, 5 oz Soap Brown dissolved in 1 pint cooling water Suitable colours such as Bismarck Brown may also be incorporated

Perfumes like terpineol, citronella, carraway oil, anise oil, mirbane or artificial oil of almonds, etc may then be added and after some crutching the filling agents including silicate of soda, starch sulphate of soda, etc may be crutched in Finally frame It may be easily understood that the yield of soap made by this process is the greatest possible since no part of the ingredients is lost during manufacture The soaps by cold process have a compact mass and do not crack The elimination of high temperature renders them highly suitable for the incorporation of perfumes The soaps can also be produced on a small scale and can be cut into decent tablets But the quality is not very high on account of incomplete saponification Both fat and alkali may be present in the free state, both of which are injurious Free fat causes rancidity while free alkali causes the soap to work harsh and feel sharp to many skins The soaps sweat on exposure to air, dry up, do not look well when old dissolve freely in water and hence lather freely

A few recipes follow —

WINDSOR SOAP

White Soap (Tallow and Coconut Oil)	75	lbs
Citronella Oil	1	lb

PROCEDURE —Proceed as above The soap is then framed, slabbed, barred and punched as usual

Brown Windsor Soap

Soap	75	lbs
Cotton Seed Oil	2	lbs
Oil of Mirbane	1	lb
Bismarck Brown	1	oz

Procedure —Proceed as above

Almond Soap

Coconut Oil	20	seers
Tallow	30	,,
Caustic Soda Lye	25	,,
Oil of Mirbane	¼	seer
Oil of Bergamot	¼	seer

Procedure —Proceed as above

Rose Soap

Coconut Oil	50	seers
Caustic Soda Lye (37 5° Be)	25	seers
Oil of Rose Geranium	12½	tollahs
Oil of Bergamot	12½	tollahs
Tincture of Musk	1¼	tollahs
Eosine	2½	tollahs

Procedure —Proceed as above

Lemon Soap

Coconut Oil	25	seers
Tallow	25	seers
Caustic Soda Lye (37 5°Be)	25	seers
Oil of Lemon	6	ch
Oil of Bergamot	12½	tollahs

Oil of Lemongrass	15	tollahs
Oil of Cloves	6¼	tollahs

PROCEDURE —Proceed as above

VIOLET SOAP

Coconut Oil	20	seers
Tallow	10	,,
Caustic Soda Lye (37 5°Be)	12½	,,
Dried Orange Peel	12	ch
Violet Root	1¼	seer
Tincture of Musk	3¾	tollahs
Oil of Bergamot	2½	tollahs
Oil of Citron	2½	tollahs
Oil of Cassia	3¾	tollahs
Oil of Neroli	2	tollahs
Peru Balsam	1¼	tollah
Tolu Balsam	½	tollah

PROCEDURE —Proceed as above

ORANGE SOAP

Coconut Oil	25	lbs
Tallow	25	lbs
Caustic Soda Lye (37 5°Be)	25	lbs
Oil of Orange Peel	6	oz
Oil of Cinnamon	½	oz
Oil of Thyme	10	drs

PROCEDURE —Proceed as above

TOILET SOAP BY REMELTING

When preparing soap by remelting, first a soap of good quality and light colour is

selected The soaps are then cut into thin shavings with chipping machines and are then charged into the remelter Soaps made both by cold and boiling processes are suitable for the purpose It is advisable to allow some hot water or steam into the remelter to give the soap the necessary degree of moisture

The soap when melted is transferred into a crutcher where colours and perfumes are mixed and then the soap is allowed to be run into frames

Bouquet Soap

Tallow Soap	20	seers.
Coconut Oil Soap	10	seers
Oil of Bergamot	3	oz
Oil of Rose Geranium	1	oz
Oil of Carraway	¾	oz
Oil of Citronella	¾	oz
Oil of Lavender	½	oz

Santal Soap

Tallow Soap	25	seers
Santal Oil	1	seer
Bergamot Oil	10	oz

Heliotrope Soap

Tallow Soap	20	seers
Oil of Almonds	1	oz
Oil of Neroli	2	oz
Benzoin	3	oz

Almond Soap

Tallow Soap	75	lbs
Coconut Oil Soap	25	lbs

Oil of Bitter Almonds	12	oz
Oil of Citronella	2	oz

Windsor Soap

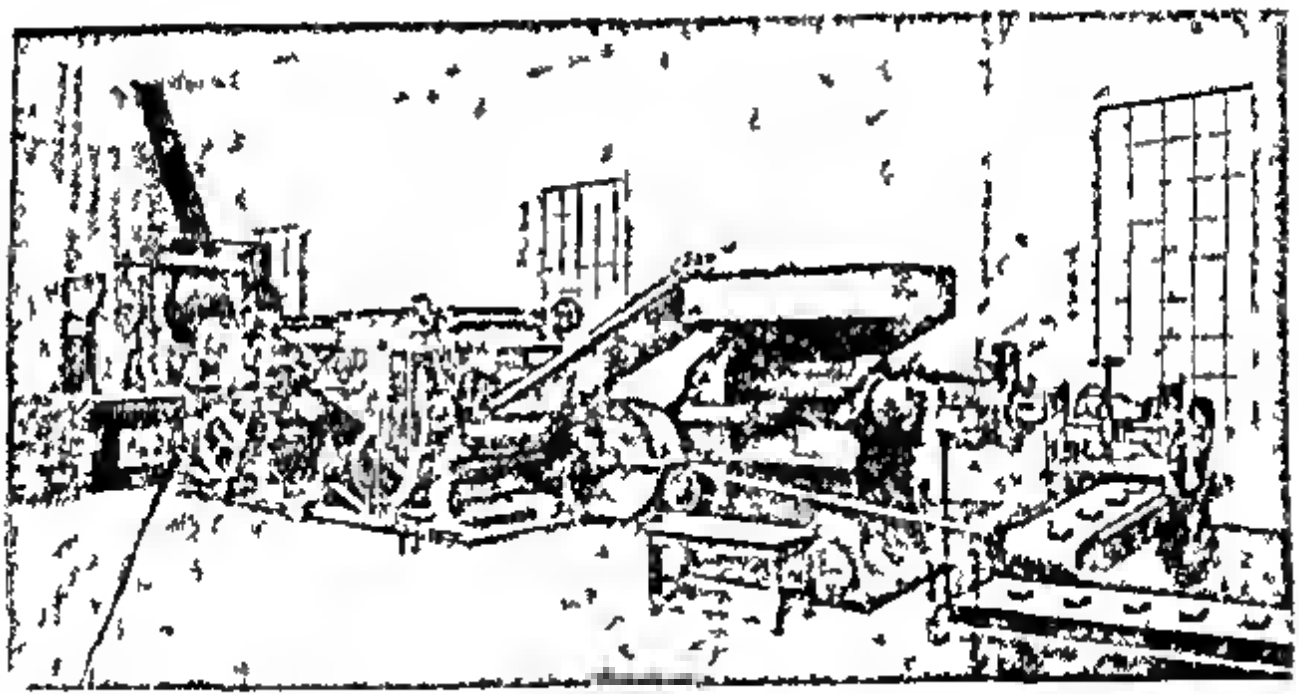
Tallow Soap	50	lbs
Coconut Oil Soap	25	lbs
Cotton Seed Oil Soap	25	lbs
Oil of Cinnamon	4	oz
Oil of Cloves	2	oz
Oil of Carraway	1	oz
Oil of Sassafras	2	oz
Oil of Bergamot	4	oz
Bismarck Brown	8	oz

MILLED SOAP

The toilet soaps made by the milling process are far superior to those made by the previous process They have a uniformly denser structure lesser proportion of water and a neat glossy appearance and are not quickly wasted The process is mainly mechanical requiring the use of additional machines, such as cutting machine, drying machine, crushing machine squeezing machine, steam stamping machine etc

On account of the laborious processes to be undergone it is only the highly priced varieties that are made by the process The soap stock should therefore be of the finest quality, free of alkali or any unsaponified fat No inferior materials should go into the composition of such stocks Ordinary soaps made

Fig 15



View of Toilet Soap Factory

[Ref page 15]

of tallow and coconut oil are best suited to be milled and should be properly boiled on strength (*p 60*), fitted (*p 61*) and settled (*p 62*)

GENERAL METHOD

First cut the soaps into very thin strips The finer the scrapings, the quicker they will dry These are then transferred to the drying chamber through which a current of hot air at 60°C may be made to pass (*p 79*) The soap should neither be too dry, nor too damp Usually 10 to 15 per cent of moisture in soap is the right degree of dryness to aim at If a greater proportion of moisture be present the soap will not work smoothly in the subsequent stage while a lesser amount of water will cause the soap to be irregular in texture

The perfumes and coal tar colours, if any, are now mixed with the soap which is sent through the crusher (*p 80*) By the milling operation, repeated thrice or four times a perfect amalgamation is ensured The pressure between the rollers may be increased by suitable adjustment as the operation nears completion The mineral colours are best added to the soap stock when in a paste condition These being fire proof are not affected by heat

The crushed stock is next passed through the plodder (*p 81*) which squeezes the soap and causes it to pass through a narrow mouth The perfumes may be added at this stage

The pressure under which the soap is expelled makes it glossy The mouthpiece however tends to get hot and the emerging soap bars become soft and fail to secure a high polish In such cases the mouthpiece is to be cooled down by passing cold water round it in a jacket provided for the purpose The heating of mouthpiece at the extreme end is however, recommended, for it imparts a high gloss While working the machine the first batch that emerges being not fully compressed, is returned to the machine If not fully compressed the soaps may crack on keeping If the mass be too dry for working, a little glycerine may be mixed with the soap otherwise the texture of the soap will lack in uniformity

I

Tallow	10 parts
Coconut oil	1½ parts
Best refined lard	1 part
Caustic soda lye	q s

PROCEDURE —Melt out the tallow and oils and pump the mixture into the soap boiling pan Heat up When nearly boiling add caustic soda lye of 40°Tw and continue boiling for about 2 hours until all the oil is saponified (which is known to be the case when no oily specks can be observed floating on the surface of the soap) Then salt out by putting salt over the surface of the boiling mass until the soap is found to have separated from

the spent lye, and floats freely on the top of the spent lye Now remove the fire and leave the pan to settle till the following morning Now run off the spent lye through the stop cock at the bottom of the soap pan, until the soap commences to flow The stopcock is then closed The spent lye which has been run off contains the separated glycerine, which may be recoverd afterwards

Now, boil up the soap again, at the same time gradually run in caustic soda lye of 30°Tw until the residual fatty matter of the previous operation, has been completely sapo nified

The addition of caustic soda lye must be made slowly and very cautiously while a steady boil and close observation are in pro gress, otherwise the soap will contain traces of free alkali, which is objectionable, as the soap must be perfectly neutral The batch is again boiled for about three hours and again "salted out' as before with a sufficient quantity of salt To ascertain whether the salt is added in excess, a metallic rod is plung ed into the boiling mass and is gently drawn out If no soap adheres to the rod then it must be concluded that the salt has already been added in excess and no more is required Now the pan is removed from the fire and allowed to rest till the next day, when the half spent lye is drained off through the valve until the soap commences to flow

The pan is again heated to boiling and water is added over the surface in a steady constant stream until the soap is quite free from liquor and is closed, and grains and no sponginess can be observed Afterwards the pan is allowed to rest for a day or two and run into frames The soap thus prepared is the stock soap for the manufacture of toilet soap Then proceed as shown on *page 159* After thorough incorporation the soap is forced through a die plate by heavy pressure f ming a long bar which is cut into cakes These are then stamped and pressed in the desired shape

Bouquet Soap

White soap	100	lbs
Oil of bergamot	6	oz
Lavender water	1	oz
Oil of rose geranium	1	oz
Oil of carraway	1	oz
Oil of citronella	1	oz

Almond Soap

Tallow soap	100	lbs
Coconut oil soap	25	lbs
Oil of mirbane	3	lbs
Oil of bergamot	1	lb

Santal Soap

Tallow soap	100	lbs
Santal oil	5	lbs
Oil of bergamot	1½	lbs

Citron Soap

Tallow soap	100	lbs
Coconut oil soap	25	lbs
Oil of bergamot	6	oz
Oil of lemon	6	oz
Oil of citron	4	oz

Rose Soap

Tallow soap	75	lbs
Coconut oil soap	25	lbs
Oil of geranium	½	lb
Oil of rose	2	oz
Oil of cinnamon	2	oz
Oil of bergamot	1	oz
Oil of cloves	¼	oz
Eosine	1	oz

Millefluer Soap

Tallow soap	75	lbs
Coconut oil soap	25	lbs
Oil of bergamot	2	oz
Oil of lavender	1	oz
Oil of cloves	½	oz
Oil of nutmeg	½	oz
Tincture of musk	½	oz

Musk Soap

White soap	100	lbs
Powdered orris root	10	lbs
Musk	30	grains
Cassia oil	1½	oz
Lavender oil	1½	oz
Bergamot oil	4½	oz

Citronella oil	1½	oz
Vermilion	3	oz
Soap brown	3	oz.

Elder Flower Soap

Tallow soap	50	lbs
Coconut oil soap	50	lbs
Oil of bergamot	2	lbs
Oil of lavender	½	lb
Oil of carraway	½	lb
Oil of peppermint	¼	lb
Oil of thyme	2	oz

Savon Orange Soap

Tallow soap, white	3000	parts
Coconut oil soap scraps	750	„
Flour	250	„
Oil of neroli	10	„
Oil of orange	10	„
Oil of petit grain	10	„
Oil of bergamot	5	„
Essence of lemon	5	„
Essence of geranium	10	„
Infusion of civet	10	„
Infusion of musk	10	„

Lily Soap

Wax soap	3000	parts
Starch	300	„
Oil of bergamot	16⅔	„
Oil of geranium	6⅔	„
Oil of cassia	1½	„

Oil of sandal wood	⅕	part
Oil of cedar	3½	parts
Tincture of musk	3½	„
Tincture of tonka bean	3½	„
Tincture of storax	10	„

Glycerine Soap

Nearly all soaps contain a small quantity of glycerine which is not separated in the lyes In some cases, however, a much larger quantity is desired, up to some 6 or 8 per cent To mill this great care is required, for the soap tends to blister during compression The best way is to dry the soap somewhat further than is usual till it contains say, only 9 or 10 per cent moisture and then mill in the glycerine A recipe follows —

Coconut oil	50	lbs
Caustic soda lye (37 5°Be)	50	„
Glycerine	4	„
Oil of rose geranium	1½	„
Oil of sassafras	¾	„
Oil of thyme	¾	„

CHAPTER VIII

TRANSPARENT SOAP.

IN making transparent soaps refined tallow, stearic acids and liquid oils are generally used Castor oil gives the best kind of transparent soap but it makes the soap sticky and the scents fugitive Coconut oil yields a reliable variety

When tallow and oils of inferior quality are used, these should be melted on a mild fire and strained through a piece of cloth to remove impurities which would otherwise diminish the transparency of the soap

One of the most important ingredients which impart transparency to the soap is alcohol This is a better solvent of soap than water and greatly promotes saponification when it is employed in addition to caustic lye Hence transparent soaps usually contain alcohol which leaves a transparent mass after evaporation

Alcohol to be used for the purpose need not be pure rectified spirit 90 per cent industrial alcohol denatured with 5 per cent wood naphtha will serve the purpose as well

Glycerine also promotes transparency but when present in excessive quantity, it is liable

to make the soap rather soft and sticky Sugar also increases transparency and improves the structure But being a hygroscopic substance, too much of it makes the soap sweat and slippery

Transparent soaps are also made by dissolving tallow or soft soaps, rendered perfectly free from water, in warm alcohol The presence of rosin in the soap favours transparency

Hence it is common with the manufacturers to use tallow rosin soap which has been dried and sliced into small pieces

The soaps are, however, made both by the cold and hot process During manufacture precautions should be taken to ensure complete saponification

The principles of manufacture will be evident from the typical recipes that follow It will be seen that reliance is not placed on any of the ingredients which promote transparency, for as already explained too much of any ingredient has a deteriorating influence on the soap It is only when the various ingredients are added in proper proportions as not to any way disqualify the soap for the purpose it is meant, that the best results are capable of being achieved

I

Soap	50	lbs
Alcohol	50	,,

PROCEDURE —Use either tallow or soft soap Cut into thin slices or shavings which are then dried over a water bath or by hot air It is sometimes the practice to powder the soap after drying The soap and the alcohol are then put into a still heated by a water bath Only moderate heat is applied otherwise the spirit would pass over without dissolving the soap

If it is desired to colour the soap any colouring matter soluble in alcohol may be employed and it is best to colour the spirit before adding it to the soap To colour the soap red a strong tincture of archil may be used and for yellow turmeric may be employed Aniline colours however are well suited to this purpose

When the soap is completely dissolved it is allowed to rest for an hour or more according to quantity after which the char and transparent liquid is put into the frames in which it will solidify on cooling When cold the soap is cut into pieces of any required size and these are moulded in the same way as other toilet soaps The soap does not however acquire its characteristic transparency until after it has been exposed to dry air for a considerable time

II

Soap	100 lbs
Methylated spirit	36

Crystal sugar	12	lbs
Glycerine	12	„

PROCEDURE —The soap is first dried and shaved, then it is dissolved in the methylated spirit at a temperature of 130° to 160°F in a still provided with a condenser to recover the alcohol The solution is then left aside Salt, carbonate of sodium and sulphate of sodium, if present in the soap, will separate out The clear portion is drawn off and heated till ¾ths of the alcohol are evaporated Then frame colour, perfume and cool The soap becomes transparent with the evaporation of the rest of the spirit

III

Stearic acid	50	lbs
Coconut oil	110	„
Castor oil	40	,
Caustic soda lye (37 5°Be)	100	„
Methylated spirit	120	„
Crystal sugar	40	„
Glycerine	40	„
Safranine	2¼	

PROCEDURE —Melt the first three ingredients and stir in caustic soda Allow to stand for a few days Now add spirit to dissolve the soap and heat to 130° to 160°F till a transparent liquid is obtained Saponification is complete by this time To recover the alcohol the volatilisation of alcohol may be conducted in stills provided with suitable conden

sers Finally add the sugar dissolved in 4 gallons of water and the glycerine Add the colour and perfumes, if necessary, and crutch well Put into frames, slab, bar and cut Place for some time in a cool dark room The alcohol then evaporates gradually and the soap hardens and becomes perfectly transparent

IV

Tallow or stearic acid	60	srs
Coconut oil	50	,,
Castor oil	40	,,
Caustic soda lye (37 5°Be)	75	,,
Methylated spirit	50	,,
Crystal sugar	20	,,
Water	20	,,

PROCEDURE —The fats and oils are melted at a gentle heat Add the caustic soda lye and stir well to ensure thorough admixture The saponification will be finished in 3 to 4 hours Then add the alcohol and other ingredients including any suitable colouring matter and perfume and finish as usual

V

Tallow	48	srs
Coconut oil	40	,,
Castor oil	60	,,
Caustic soda lye, (37 5°Be)	74	,,
Crystal sugar	36	,,
Water	36	,,
Glycerine	6	,,
Soda crystals	10	,,

PROCEDURE —Melt the fats and oils and stir in the lye, set aside for 24 hours, then boil for 3 to 4 hours to complete the saponification The soap is then allowed to cool to 170°F It has then a jelly like appearance Now add with brisk agitation glycerine and crystal sugar, then soda srystals, colour and perfume and finish as usual

VI

Tallow	54	lbs
Coconut oil	44	„
Castor oil	54	„
Caustic soda lye 37 5°Be	84	,
Crystal sugar	48	„
Water	26	„

PROCEDURE —As in (III)

GLYCERINE SOAPS

Glycerine soaps are hard transparent soaps made from a neutral settled soap stock These soaps are generally made of tallow and coconut oil and contain a small proportion of rosin and about 20 to 30 per cent of pure glycerine

The soaps are generally coloured decently to captivate public attention To colour red dish brown use is made of leather brown (commercial brand), for violet use methyl violet with English brown, for yellow, use uranium yellow, for red use scarlet red There are to be dissolved in the least amount of denatured alcohol or boiling water

I

Tallow	30	lbs
Coconut oil	50	,,
Castor oil	30	,,
Caustic lye 38°Be	55	,,
Glycerine	12½	,,
Syrup	12½	,,
90% Alcohol	50	,,
Colour to choice	*q s*	
Musk	1	dr
Bergamot oil	3	oz
Lavender oil	5	,,
Cananga oil	8	,,

PROCEDURE —Melt tallow and oils in a clean soap kettle Pour in the caustic lye preferably strained through a cloth and stir till the mass thickens Keep aside for half an hour and then boil the soap mass on a water bath stirring continuously When saponification is almost complete add the freshly prepared syrup Boil for about an hour more and add alcohol after reducing the temperature of the furnace (*p 72*) The soap dissolves in the alcohol and into this colours may be added Now cover the pan and boil at a mild heat When soap is ready take the pan away from fire and add the scents Keep aside and run into moulds prepared of galvanized tin sheet (24" gauge) in the shape of pipe having the diameter of the soap required The end of the mould is provided with a removeable cover which is luted with a paste made of earth and

flour When cold, the soap sets and can be drawn out unbroken by slightly heating the mould and pushing with a stick having at its end a piece of board exactly fitting the cross section of the mould Cut the soap-bars into suitable pieces, and expose to the air to dry, polish with a cloth moistened with alcohol and stamp Before packing polish again with moistened cloth as before

II

Tallow rosin soap	20	lbs
Alcohol (90 per cent)	8	pint
Glycerine	5	lbs
Leather brown	10	gr
Alcohol or Water to dissolve Colour	6	oz
Geranium oil	½	,,
Cassia oil	1	,,
Lavender oil	2	,
Sandal oil	½	

PROCEDURE —Dissolve soap in alcohol in a covered pan on water bath Add glycerine and colour previously dissolved in boiling water or alcohol Distil off the alcohol and collect it for future use if possible, in a reflux condenser Then crutch in the perfumes and mould as in the previous recipe

The soap cuttings may be remelted and remoulded as already stated The cuttings may also be used in the soap stock before crutching and moulding

III

Tallow	20	lbs
Coconut oil	10	„
Caustic soda lye 40° Be	15	„
Alcohol 96%	12	„
Glycerine	15	„
Brown sugar	6	„
Water	2	„

PROCEDURE —Fresh tallow 20 lbs and best coconut oil 10 lbs are heated at 170°F On the other hand 15 lbs of solu ion of caustic soda 40°B, 12 lbs of 96 p c alcohol, 15 lbs of glycerine, 6 lbs of brown sugar are mixed together with 2 lbs of water and likewise heated to 170°F and the mixture gradually mixed with the former under brisk stirring Saponification takes place in this manner without the necessity of boiling The reaction is accompanied by a considerable increase in bulk It may be now covered and after it has a little cooled it may be scented Finally it is poured into moulds which must be so placed as to prevent soap from congealing quickly

CHAPTER IX.

SOAP POWDER AND LIQUID SOAP.

OF late the use of soap powders as a general cleansing agent has become popular. They are employed for scouring purposes in the household. They may be manufactured at a low cost, still retaining their detergent properties. Being a readily seleable article they prove more lucrative than ordinary soap.

A number of recipes for making soap powder follow. The chief ingredients which enter into the composition of soap powder are also incorporated with soap, e.g., salt, soda ash, tripoli, silex, felspar, infusorial earth, etc. Besides these, various filling compounds with true cleansing and bleaching properties are added to the soap, for example, sal-ammoniac, carbonate of ammonia, sodium perborate and the peroxides of various metals. But these are comparatively expensive ingredients.

GENERAL METHOD OF MANUFACTURE.

In manufacturing soap powders, the dried soap chips may be mixed with the filler and alkali and then pulverised. Another economical method is to mix the ingredients in a mixer, specially adapted for heavy material until dry and then to run the mass directly to

the crusher and pulveriser There are automatic devices for packing, sealing and boxing the soap powder

A few typical recipes are given —

I

Settled soap	2½ lbs
Soda ash 58°	4 ,,
Silica	22 ,,
Salt	1 lb

PROCEDURE —The ingredients are mixed in a specially adapted mixer for heavy material until dry Then run directly to the crusher and pulveriser After this it is packed, sealed and boxed

II

Settled soap	2 lbs
Soda ash 58°	3 ,,

PROCEDURE —As in (I)

III

Settled soap	1 lb
Soda ash 58°	4 lbs

PROCEDURE —As in (I)

IV

Yellow soap	6 parts
Soda crystals	3 ,,
Pearl ash	1½ ,,
Sulphate of soda	1½ ,,
Cotton seed oil	1 part

PROCEDURE —These ingredients are mixed as finely as possible without the addition of any water The mass is then spread out to dry and then ground into a coarse powder Thus in an infinite degree can the variety of soap powders be multiplied This soap is adapted to hard waters, as the excess of alkali neutralises the lime.

V

Hard soap	5	parts
Soda ash	3	,,
Silicate of soda	2	,
Borax	1	part

PROCEDURE —Each ingredient is thoroughly dried and mixed intimately

VI

Soap	85	lbs
Filler	40	,,
Sal soda solution 20°Be	17	,

PROCEDURE —The dried soap chips are mixed with the filler and alkali and then pulverised

VII

Washing Soap	3½	parts
Soda Crystals	12	,
Pure alkali	3	,
Sodium bicarbonate	1½	,

PROCEDURE —The washing soap should be previously dried and cut up fine Put down

12 parts of soda crystals and spread out on the floor, on the top of this spread the best washing soap On the top of this spread 3 parts of pure alkali and 12 parts of bicarbonate of soda Put this through the edgestones to have the ingredients crushed and mixed well and let stand all night before putting through the disintegrator which reduces the mass to fine powder

VIII

Soap	8	cwt
Pure alkali	15	„
Water	16	„

PROCEDURE —Place in the tank 16 cwt of water, heat with live steam to 180°F Cut up 8 cwt of soap into small pieces, throw it in the tank with the stirrers going at slow speed Pass on steam until the soap has quite dissolved then turn off letting the mass agitate for an hour Now add gradually 15 cwt of pure alkali 58% and let the stirrers continue until the whole is well mixed in The valve at bottom of tank can now be opened and the contents of the tank run to a cooling tank where it is kept aside for at least 18 hours so that the soap formed is hard enough to be ground The material when dry is dug out the vats and passed through set of edge runners to break the lumps and is then passed through disintegrator which will reduce it to a very fine powder

LIQUID SOAP

Liquid soaps are merely solutions of a potash soap, usually coconut oil soap

I.

Coconut oil	130	seers
Caustic potash lye, 28°Be	125	
Sugar	72	„
Borax	2	„
Water	267	„

PROCEDURE —The oil is run into a jacketed kettle and heated to about 120°F The potash lye is then added to the oil Saponification takes place the mass swells rapidly and may foam over the sides unless a kettle of about four to five times the capacity of the total charge of soap is used When the saponification has occurred the sugar, borax and glycerine are added, the water is run in and the mixture stirred until the soap is thoroughly dissolved Heat helps materially in dissolving the soap The soap is then allowed to cool and if colour or perfume is to be added this is stirred in

II

Cotton seed oil	9	parts
Caustic soda	8	„
Caustic potash	8	„
Alcohol	35	„
Distilled water sufficient to make	500	„

PROCEDURE —In a suitable container, dissolve the caustic soda and caustic potash in

50 parts of distilled water, add the alcohol and then add the cotton seed oil in 3 or 4 portions, shaking vigorously after each addition Continue to agitate the mixture occasionally until saponification has been completed Then add the remaining portion of water and mix The only precautions that are at all necessary are to use a good grade of ingredients, and to be sure that saponification is complete before adding the remaining portions of the distilled water The water used must be absolutely free from soluble salts and for this reason it is preferable to use only freshly distilled water

LIQUID TOILET SOAP

Lard, best quality	30	parts
Sesame oil	6	„
Caustic soda lye (40°Be)	3	„
Caustic potash lye (40°Be)	14	„

PROCEDURE —30 parts of lard and 6 parts of sesame oil are heated on a water bath to 38°C, the mass being kept as near this temperature as possible during the subsequent operations first 3 parts of caustic soda lye of 40°Be previously mixed with one part of water (4 parts) are stirred in a thin stream and then 14 parts of 40°Be caustic potash lye are crutched in similarly The soap mass is now stirred uninterruptedly, still at the above temperature, until it becomes so thick that stirring is no more possible, this frequently

takes some hours, when complete saponification of the fat takes place

The perfume is ground up in the cold soap cream, sometimes with the addition of 2 per cent of vaseline

LIQUID GLYCERINE SOAP

I

Melt together 274 lbs pale oleic acid, 66 lbs coconut oil, 228 lbs caustic potash lye, 60°Tw, then add, boil up, and when saponified add 20 lbs glycerine and enough methylated spirit to make the liquid clear The glycerine should be free from lime

II

Take 10 seers of soft soap, i e , soap made with caustic potash The soap should be salted out with potassium chloride to render it perfectly free from alkali Melt it and incorporate into it 20 seers of glycerine which should be free from lime The liquid soap thus prepared may be scented with rose oil and orange blossom oil in equal proportions, the actual amount used being varied according to taste

CHAPTER X

FLOATING SOAPS

THESE are soaps that swim in water by reason of the air enclosed in them They are therefore used for bathing purposes

I

Tallow	135	seers
Coconut oil	15	seers
Caustic soda (9° to 12°Be)	16	gallons
Caustic potash (9° to 12°Be)	5	gallons
Salt	16	seers

PROCEDURE —Saponify 135 seers of tallow and 15 seers of coconut oil in the ordinary way in a large soap kettle with soda and potash lye of 9° to 12°Be until a clear dark paste is obtained with a slightly alkaline touch In order to make the stock soap of a good quality boil the soap after it is fitted for two hours more on a gentle fire After all the fat is saponified salt out the soap with 7 to 8 per cent of salt so that some lye separates out Now increase the fire add more salt solution of 3° to 4°Be continue boiling until the soap froths up well for 1 hour The mass now boils quite light and flaky If the mass is too strongly salted out water is added until the lye begins to form a paste Then withdraw

the fire and allow to stand quietly for a quarter of an hour The sub lye will separate out and the soap can then be put into frames not very water tight, so that lye may escape Scoop out the soap from the top of the kettle only and fill halfway two low frames of 10 to 12 mds capacity Cover them up to retard solidifying Now work up the remainder of the soap in the kettle to a froth by means of paddles or stirrers and allow to stand 2 to 3 minutes Divide the mass into 2 portions and pour into the frames Crutch the contents of the frames quickly into the curd until the whole becomes uniform Repeat this operation for 2 or 3 times until the mass becomes quite porous and flaky Cover up the soap with a lid fitting into the frame and weight with 25 to 40 seers so that it lies directly on the soap

The framing and crutching of the frothy soap must be done quickly as the soap is liable to solidify soon and cannot be worked long

If the soap is to be coloured red or rose the *colouring matter (generally alcanna root)* is dissolved in the hot fat to give it the required shade The perfume, however, is added to the soap in the frame before completing the crutching As alcanna root, with an excess of alkali, easily acquires a violet hue it is best to use a red lye proof colour that is soluble in water

After two days the soap can be cut up into blocks and bars It is advisable to leave the bars exposed to the air for one day to dry

The cuttings are kept until the next boiling and added when the soap is salted out

II

Good oil soap	27 seers
Water	2½ seers

PROCEDURE —Make the soap into shavings Now melt the shavings by the heat of steam or water bath in a pan furnished with an agitator, which must be assiduously worked till the soap has at least doubled its volume Next put into frames, cool, and cut into pieces The soap lathers well and is very pleasant. Any scent may be added during framing

III

Coconut oil	10 seers
Caustic soda lye, 38°Be	5¼ ,,
Caustic potash lye, 25°Be	¼ seer
Potassium chloride solution (20°Be)	2½ seers

PROCEDURE —Melt the oil and filter Heat to 90°-100°F and add the alkali with stirring When combination is complete cover up the pan Now add 2½ seers of potassium chloride solution of 20°Be and 10 to 12½ seers of hot water and stir till a uniform mass is obtained Allow to cool to 77°F Now beat a small portion of soap with paddles or

air brushes When the mass is frothy, add the rest and stir Finally frame, crutch, cool and stamp

IV

Coconut oil	50	lbs
Tallow	25	,,
Caustic soda lye (36°Be)	40	,,
Potassium carbonate solution (20°Be)	40	,,
Potassium chloride solution (20°Be)	20	,,
Brine (20°Be)	25	,,

PROCEDURE —Proceed as usual with coconut oil tallow and caustic soda When the saponification is attained, the pan is covered up Then the potassium carbonate, potassium chloride and brine are poured in gradually with double their weight of hot water When cool beat the soap to enclose air and become frothy Finally frame, crutch, cool and stamp

CHAPTER XI

MOTTLED SOAPS.

GENUINE mottled soaps are generally prepared from low grade tallow, bone grease or kitchen grease, with a cheap quality caustic soda The impurities from the raw materials produce the mottling (*p 7*)

The mottled soaps as a general rule are made by the boiling process, being pasted, grained and then boiled with strong lye, when the saponification is found to be complete, the boiling is continued until the soap is just sufficiently open to mottle properly on cooling, this being a point which can only be determined by practical experience When the right condition is reached the soap is allowed to rest for an hour or two and then quickly run into wooden frames For good results the frames should be covered with blanket in order to ensure slow cooling

Mottled soaps are however often made by artificial means These have copperas ultramarine or manganese dioxide to produce the mottle according to the colour of the mottle required The ultramarine will produce a blue mottle while manganese dioxide, vermilion and copperas will yield grey, red and green mottles respectively

TWO KINDS

There are two kinds of mottled soap known One has a faint grey mottle scattered through its substance while the other has a prominent mottle or grain of a blue red or other colour We will deal with former type first

The fats and alkalies used in this preparation are generally contaminated with earthy matters and metallic impurities these acting upon the fats formed by the alkali

To produce mottled soap with a good grain requires some experience in soap boiling The method usually followed is to make a soap from tallow or bleached palm oil using low grades of caustic and adding it in large excess The soap is well boiled and then it is boiled down with some lye until it begins to curd out it is at once run into the frames and these are covered over with cloths to keep in the heat During the cooling the metallic soaps tend to aggregate together and so produce the mottle One of the chief arts in making a mottled soap lies in the boiling if boiled too long it sets too quickly and there is not time for the mottling to form properly which if not boiled long enough it is apt to contain an excess of lye and the mottling settles out too quickly

BLUE MOTTLED SOAP

At first soap is prepared from tallow and palm kernel oil or coconut oil The soap

is afterwards removed to a second pan and for every 1,000 lbs soap are added 250 lbs of silicate of soda solution, the whole being tho roughly incorporated by boiling until the proper condition of mottling has been reached This can be determined only by experience The colouring matter, ultramarine blue, worked up into a thin paste with water, is then slowly sprinkled over the surface of the boiling soap until the full quantity has been introduced, the amount of ultramarine blue to the portion of soap varies from 5 to 10 lbs If the soap is in too liquid a state the colouring matter is apt to permeate the entire mass giving it blue tint throughout, and the desired mottled appearance will not be attained When properly conducted the blue pigment shows in the soap in blue patches which appear in strong contrast to the white ground of the soap, giving it a pleasing appearance to the eye

I

Coconut oil	10 seers
Cotton seed oil or low grade tallow	15 "
Caustic soda lye 40°Be	12½ "
Silicate of soda	1¼ "
Water	1 seer
Soda ash	1 seer
Ultramarine	q s

PROCEDURE —Boil the oils with caustic lye When the saponification has been com

pleted, add liquoring materials consisting largely of silicate of soda solution, together with soda ash and brine The soap should be distinctly alkaline (*p 110*) The mixture is thoroughly boiled until a sample withdrawn and tested is found to be in a suitable condition for adding the colouring matter Add ultra marine in the proportion of 3 to 3½ lbs per ton This may be either suspended in a small quantity of water or mixed up with a little of the soap, and sprinkled over the contents of the pan The soap is then further boiled up until the colour is thoroughly distributed when it is run into wooden frames, and the frames are covered over with sacking or blanket to allow the soap to cool slowly

The ultramarine is often worked up into a thinnish paste with water and is then sprinkled over the surface of the boiling soap a little at a time until the full quantity is added

GREY MOTTLE

PROCEDURE —Proceed in the same way and colour with powdered oxide of manganese, from 1 to 3 lbs to the ton, introduced in the same way as above

RED MOTTLE.

PROCEDURE —Same as above only colour with vermilion

CHAPTER XII

SOFT SOAPS.

SOFT soap is an amber coloured to reddish brown material of the consistency of butter These are more soluble in water than ordinary soaps and possess greater scouring properties (*p 4*) Light coloured soaps are preferred The alkali used in their manufacture is caustic potash

Linseed oil is chiefly used in making soft soap It is readily saponified yielding a transparent amber coloured soap with a pleasant odour Cotton seed and fish oils are also employed for the purpose Cotton seed soap when newly made is as good as linseed oil soap but it soon acquires a rancid odour Fish oil soaps have a fishy odour Olive oil and coco nut oil give good quality soft soap

METHOD OF MANUFACTURE

In making the soap lyes are to be made of 10°Be 16°Be, 23°Be When boiling the soap by direct fire it is wise to start with the weaker lye which gets gradually concentrated with the evaporation of water

Addition of a little carbonate of potash promotes brightness When finished, run into firkins or tin canisters to cool

For cheapening the product rosin is sometimes added The method of adding rosin is the same as in pale soap (*p 144*) Neutral silicate of potash (37 5°Be) may be run in as a filling agent (*p 68* & *110*) This is run in when the soap is finished and crutched

I

Fish oil	1	maund
Linseed oil	2	maunds
Caustic potash lye 20°Be	6	maunds

PROCEDURE —Take half of the oil and saponify with half its volume of potash lye of 10°Be Send open steam and stir well When the mass fobs add more lye and boil Take care that the oil does not boil over When the oil and lye are well amalgamated add rest of the oil and lye of 20°Be and boil Add hot water to keep the mass thin When the soap is clear and transparent, it is ready to be framed

II

Linseed oil	250	lbs
Cotton seed oil	250	,,
Rosin	50	,,
Caustic potash lye, 20°Be	500	,,
Caustic soda lye, 22°Be	145	,,
Pearl ash	25	,,

PROCEDURE —Proceed as above To fill in soap first crutch in silicate of soda at the rate of 7 lbs to the firkin Next prepare a

mixture of starch and caustic soda lye 24°Be. Heat to about 150° or 160° F and add farina in small quantities at a time waiting until each portion is dissolved before adding the next. The farina is added until a mass of the consistency of soft soap is obtained

III

	A	B	C
Linseed oil	1 md	1 md	2 mds
Cotton seed oil	2 mds	2 mds	1 md
Tallow	——	½ md	——

IV

Cotton seed oil	1 md
Linseed oil	1 md
Fish oil	1 md

V

Coconut oil	1 md.
Tallow	½ md
Lard	½ md

VI

Linseed oil	400 lbs
Tallow	135 "
Rosin	50 "
Caustic potash lye 20°Be	740 "
Caustic soda lye 22°Be	40 "
Pearl ash	25 "

CHAPTER XIII

MEDICATED SOAPS.

THE process of manufacturing medicated soaps is very simple First of all, an ordinary stock soap is prepared in the usual way and into this is worked by means of the crutcher, or by the milling process the substance which imparts the special properties to the soap To prepare stock soap of good quality proceed as follows —

STOCK SOAP

Coconut oil	900	grams
Caustic soda lye (10°Be)	600	„

Boil the soda lye in a porcelain vessel, and gradually add the oil without stopping the heating When the mixture has become smooth add 375 grams of caustic soda lye (20°Be) The mass now becomes thicker, the heating is stopped when a small sample solidifies on cooling About ½ litre of water is then added the whole heated to boiling and 375 grams of common salt added, when the soap will separate and rise to the surface The mixture is then cooled, the water poured off, the mass mixed twice with a 20 per cent salt solution, and finally with cold water The water is allowed to drain off in a hair sieve

and the mass pressed to remove the excess of water The soap so obtained is in the form of a paste, which is brought to a suitable consistence by a very moderate heat in a drying oven, in order to enable the selected medicament to be incorporated after which the soap is pressed into tablets and dried at a temperature of from 30° to 35°C

The best way of preparing medicated soap is that done by the milled process For this purpose prepare stock soap in the usual manner by boiling according to the following formula —

Tallow	16	parts
Olive oil	2	,
Caustic Soda lye 38°Be	6	,
Caustic Potash lye 38°Be	3	,

Now take 9 parts of this stock and add to it 1 part of soda ichthyol dissolve in as little water as possible and incorporate thoroughly This soap is very suitable for rheumatism, sciatica burns chilblains and various diseases of the skin

CARBOLIC SOAPS

For this class of soaps almost any good stock soap may be used but this is usually varied according to the quality or grade of the soap Thus the lowest grades of carbolic soaps are made from the nigers of pale soaps mixed with fresh stock soap The best grades of these soaps are made from good pale soaps

made from tallow, bleached palm oil and rosin As carbolic acid has a slight acid reaction, it is a wise plan to leave the soap stocks slightly alkaline, otherwise, if quite neutral the acid may cut the soap during the mixing The usual quantity of carbolic acid added to soap varies from 5 per cent to 10 per cent This is the minimum quantity which should be added otherwise the medicinal value of the soap will be inappreciable For colour effect use meta n l yellow

For pale carbolic soaps the best crystal acid should be used Before adding to the soap this may be mixed with a small quantity of water or alcohol to render it liquid For the commoner class of carbolic soaps, which usually are of a dark brown colour the crude carbolic acid may be employed The process is simple the stock soap being run off and fitted if required the carbolic acid is crutched into it in the crutcher adding it little by little After the crutching the soap is framed and allowed to set after which it may be cut up into bars and stamped in the ordinary manner

I

First prepare coconut oil soap according to the following methods —

600 grammes of soda lye (10° Beaume) is boiled in a porcelain vessel and 900 grammes of coconut oil is gradually added without stopping the heating When the mixture becomes

smooth 375 grammes of soda lye (20° Beaume) is added The mass now becomes thicker the heating is stopped when a small sample solidifies on cooling About 500 c c of water is then added the whole heated to boiling and 375 grammes of common salt added when the soap will separate and rise to the surface The mixture is then cooled the water poured off the mass mixed twice with a 20 per cent salt solution and finally with cold water The water is allowed to drain off in a hair sieve and the mass pressed to remove the excess of water

The soap so obtained is in the form of a paste which is brought to a suitable consistence by a very moderate heat in a drying oven Now 50 grammes of carbolic acid is dissolved in 25 grammes of alcohol and the solution gradually added to 950 grammes of the coconut oil soap already prepared Add metanil yellow (2 dr for 100 lbs) dissolved in water The mixture is then made homogeneous by thorough incorporation It is then cut and pressed into tablets and dried at a temperature of from 30° to 50°C

II

First melt rosin curd soap and crutch in about 2 per cent of carbolic acid in crystals Place in a frame and when cold cut into squares and mould in the same way as in ordinary fancy soaps

III

First of all a soap basis has got to be prepared The cold process may be adopted for this purpose with 10 lbs Cochin coconut oil and 5 lbs soda lye (38°Be) Next 6 oz pure carbolic acid is dissolved in a similar quantity of potash lye and the solution stirred up with 8 oz glycerine (28°Be) The whole mixture is then added to the soap and thoro ughly incorporated The proportion of the acid may be varied to obtain the desired strength of the resulting soap

NEEM SOAP

Coconut oil	5 seers
Neem oil	1 seer
Caustic soda (70° 72°)	1 seer
Water	2 seers
Victoria blue	3 mashas
Uranine yellow	½ masha

Procedure —Dissolve the caustic soda in water and allow the solution to cool Now in another vessel mix the oils and then slowly add the caustic soda lye with continuous stir ring When the whole mixture has acquired the consistency of thick paste the colours are intimately incorporated into it after being finely ground and the creamy substance is subsequently set aside for 48 hours to settle The soap formed in this manner is next cut into suitable pieces and moulded

CHAULMOOGRA SOAP

By Cold Process

I

Coconut oil	20	seers
Castor oil	2	„
Neem oil	1	seer
Chaulmoogra oil	3	seers
Caustic soda lye 36°B	15¼	„
Soap green	2	dr
Bo ling water q s to dissolve —		
Ichthyol	1	lb
Thyme oil	4	oz
Oil citronella	4	oz

Procedure —Fresh and clear oil and clear lye should be taken The oil should just be in melted state and not hot but the lye should be cold Dissolve colour in boiling water but don't boil Other procedure is as usual

II

Coconut oil	24	lbs
Castor oil	1	lb
Chaulmoogra oil	2	lbs
Neem oil	½	lb
Caustic soda lye 36°Be	16	lbs
Sulphur sublimate	1	lb
Windsor brown	10	gr
Boiling water to dissolve	q s	
Oil citronella (Java)	2	oz
„ rose geranium	2	„

Oil cloves	¾ oz
,, sandal	¾ ,,

PROCEDURE —Mix the 1st four oils Throw in sulphur dust gradually and stir so as to incorporate it thoroughly with the mixture, then add the lye and colour and go on stirring until the mass is nearly thick Then add the perfume and mix well by stirring and frame

By Semi Boiling Process

PROCEDURE —First saponify coconut and castor oil with the lye as usual Melt separately ½ seer of Rosin with the Neem and chaulmoogra oil and mix Ichthyol and Thyme oil with it Then add this to the soap and mix well Finally mix colour and citronella oil and frame

By Milling Process

Stock soap (of hard consistency)	95	lbs
Oil chaulmoogra	5	lbs
B Naphthol	1	lb
Sulphur sublimate	2	lbs
English brown	2	dr
Dissolved in boiling water	q	s
Oil lavender	3	oz
Oil rose geranium	2	oz
Oil sandal	1	oz

PROCEDURE —Mix while in the process of milling

NAPHTHOL SOAP

Coconut oil	5	seers
Caustic soda (70° 72°)	1	seer
Water	2	seers
Naphthalene balls	14	chhataks

PROCEDURE —Powder the balls thoroughly and pass them through some linen This can be prepared by hot as well as by the cold process Dissolve the caustic soda in 2 srs of water and gradually pour over the oil and stir gently until a thick paste is obtained Next thoroughly incorporate the naphthalene powder and set aside for a day or two without disturbing Then the soap thus formed is cut and pressed in moulds

CAMPHOR SOAP

Camphor soaps are used for chilblains and in the bath for rheumatic pains

(1) SOFT CAMPHOR SOAP is made by dissolving 10 per cent of camphor in melted soft soap It is used as a salve for sores etc

(2) MILLED CAMPHOR SOAP—Add to 25 lbs of white stock soap 2 lbs of camphor finely powdered (or preferably dissolved in spirit) and incorporate thoroughly in the melting machine Cut the soap into tablets and wrap tightly in paper and tinfoil as camphor is volatile

BORAX SOAP

COMMON—90 lbs soap and 10 lbs borax

BORAX DRY SOAP—25 lbs soap, 60 lbs soda crystals 5 lbs borax 10 lbs refined alkali A better quality can be made from 25 lbs soap 10 lbs refined alkali 50 lbs soda crystals, 15 lbs borax

BORAX SOFT SOAP—Tallow or fat 20 lbs, soda lye (15°Be) 20 lbs, potash lye (10°Be) 12 lbs, solution of borax (10°Be) 3 lbs

The soda lye is added to the melted fat and heated till it forms a clear liquid or is combined, when the potash lye and borax solution are added It should be a semi solid translucent paste and is usually sold in quart cans

BORAX BATH SOAP—First prepare the coconut oil soap required for this purpose according to the following process

Put 100 lbs of coconut oil and 100 lbs of caustic soda lye 27°Be into a soap kettle boil and mix thoroughly for 2 to $2\frac{1}{2}$ hours until the paste gradually thickens then diminish until the cooling paste assumes a white half solid mass then transfer quickly to the frames

Add 100 parts of borax to 900 parts of coconut oil soap and mix until a homogeneous mass is obtained cut into pieces of required size and press and dry the pieces

BORAX SOAP POWDER—Take —

Curd (hard) soap powder	5	parts
Soda ash	3	,,
Silicate of soda	2	,,
Borax	1	part

Each ingredient is thoroughly dried, and all mixed together by sifting

MERCURIAL SOAP.

This is sometimes prepared for treating dogs and other animals, and for preserving skins in taxidermy It contains corrosive sublimate One drachm of the latter compound is dissolved in a mortar with 1 oz of rectified spirit, and 4 oz of a good soap, cut up into fine shavings, are added The whole is then incorporated by careful grinding

SULPHUR SOAP.

I

A soap containing sulphur is largely used for washing dogs, and also for treating various forms of skin disease These soaps are very simply made, a good white soap made from tallow and coconut oil is employed, and into it while melted, after it has been fitted, are stirred flowers of sulphur 10 to 20 lbs to 1 cwt of soap, a little perfume being added to impart an odour to the soap

II

Coconut oil soap	9	parts
Sublimed sulphur (finely sifted)	1	part.

PROCEDURE.—Incorporate the sulphur to the soap until a homogeneous mass is obtained, then cut into pieces and press in moulds

TOOTH SOAP

Tooth soaps are formed from a well made and neutral tallow soap, adding to it, while in a molten condition, finely sifted siliceous earth powder, prepared chalk and starch The following quantities may be taken as a guide 20 lbs of soap, 1 lb of siliceous earth powder, 2 lbs of chalk, and ½ lb of starch The ingredients are then mixed intimately Flavours may be added, if desired

COAL TAR SOAP

In making coal tar soaps use is made of naphthalene, naphthol etc in addition to carbolic acid An excess of naphthalene is to be avoided or the soap will be unpopular for strong odour The odour of the coal tar is considerably modified by and blends well with a perfume containing oils of cassia, lavender, spike and red thyme Take coconut oil soap scraps 30 parts dissolve in solution of salt of 10°Be and stir about 3 parts of coal tar Or melt together 20 parts coconut oil and 3 parts tar and saponify with caustic soda of 40°Be The soap is used for skin and other cutaneous diseases

IODIDE SOAP

Completely saponify 20 lbs coconut oil with 10 lbs caustic lye of 40°Be and then incorporate a solution of 3 lbs of potassium iodide in 4 lbs of water

LIQUID MEDICATED SOAP

Coconut oil	1 dram
Potassium hydroxide	1 dram
Sodium hydroxide	1 dram
Thymol	5 grains
Distilled water to produce	6 ounces

Dissolve the sodium hydroxide in one ounce of distilled water and dissolve in a separate vessel the potassium hydroxide in another ounce of water Now place the coconut oil in a suitable pot and pour the sodium hydroxide solution stirring vigorously until all the sodium compound has been absorbed by the oil Then add the potassium hydroxide solution and again stir so as to saponify the whole of the coconut oil Then incorporate the thymol and allow the soap to stand for 15 minutes Afterwards add the remainder of the distilled water

CHAPTER XIV

SHAVING SOAPS.

THE primary requisite for a good shaving soap is that it should produce a good and persistent lather which, when formed on the face, will remain practically permanent Its action on the skin must at the same time be neutral Naturally therefore considerable care is required to make a soap incorporating these qualities The best fats for the purpose are tallow and coconut oil and it is advisable to use both soda and potash in their preparation as better lathering soaps are obtained in this way Both the cold and the boiling processes are applicable in the manufacture of shaving soap Here are a few reliable recipes

I

Tallow	100	lbs
Coconut oil	12½	„
Soda lye of 38°Be	50	„
Potash lye of 38°Be	6	„

PROCEDURE —Proceed in the usual way as for making toilet soap, add any desired scent in suitable proportions Sometimes a little gum tragacanth (1 lb per cwt) is introduced during the process to make the lather of the product more permanent

II

Tallow	250	parts
Coconut oil	125	"
Lard	25	"
Caustic soda lye of 30°Be	275	"
Caustic potash lye of 20°Be	75	"
Oil of lavender	1	part
Oil of thyme	½	"
Oil of cumin	½	"

PROCEDURE —Melt together tallow, coconut oil and lard and allow the mixture to cool off to 115°F Then add the caustic soda lye and caustic potash lye with gentle stirring and perfume the soap with the oils stated above Set aside for a day and then cast into sticks by means of moulds

III

Tallow oil soap	75	lbs
Coconut oil soap	50	"
Oil of carraway	6	oz
Oil of bergamot	6	"
Oil of lavender	3	"
Oil of thyme	3	"
Oil of cloves	1	"

PROCEDURE —Remelt the soaps and incorporate the perfumes Finally cast into sticks by means of moulds

IV

Tallow white	80	lbs
Coconut oil	40	"

Caustic soda lye (30°Be)	64 lbs
Caustic potash lye (30°Be)	16 ,,

PROCEDURE —Heat the tallow and oil to 100°F and add the lyes as usual until the mass forms a well combined homogeneous paste The entire operation takes 15 to 20 minutes It is finished when the surface of the soap becomes covered with a film which constantly re forms notwithstanding stirring

Perfume the soap with oils of lavender and thyme, each 3½ ounces oil of cumin 7 ounces, oil of bergamot 10½ ounces or any mixture of essential oils to obtain the desired flavour The perfume is added to the soap, in suitable proportions with constant stirring, before bringing it into the frame

V

	A	B
Tallow	2½ mds	2½ mds
Coconut oil	12½ seers	20 seers
Caustic soda lye (37°Be)	1¼ mds	52 seers
Caustic potash lye (37°Be)	6 seers	2 seers

PROCEDURE —Proceed as in (II) and add suitable perfumes

SHAVING SOAP POWDER

Shaving soap powders are pure curd soap pulverised and mixed with starch almond paste, or powdered orris root These addi-

tions serve a double purpose, many very sensitive skins cannot even bear pure neutral curd soaps, their use causing an unpleasant sensation of dryness This is alleviated if soaps with the above additions are used, their presence also causes the lather to be more permanent By mixing 20 to 25 parts of starch with 100 parts of soap powder a shaving powder is obtained which gives a fine permanent lather This powder is generally supplied white, but it is also coloured rose by mixing a little cinnabar in it Before mixing the starch into the powdered soap it is perfumed and if necessary coloured, the colour and perfume being very carefully ground up, and when thoroughly mixed up the whole is passed through a not too fine sieve If the perfume is added to the powdered soaps it forms small balls which in spite of all trouble cannot be entirely got rid of and finally remain upon the sieve

The perfume usually employed for white shaving powders made with starch is a mixture of lavender oil oil of thyme, oil of carraway and fennel oil for rose powder— geranium oil palmarosa oil and a little oil of cloves and for finest rose shaving powder— geranium oil rose oil and bergamot oil

CHAPTER XV

TEXTILE SOAPS

WOOL SOAPS

WOOL soap is used to scour the wool, *i e*, to extract the dirt and grease from the wool prior to spinning The soap is made slightly alkaline, the proportion of the free alkali not exceeding 1 per cent.

The soap is made from low grade fats and oils, colour and quality are not of much importance This does not require the same amount of care as the household soap

The better quality wool soaps are made with caustic potash instead of caustic soda In this case the soap is soft and wool washed with it has a silky appearance and feels soft This also does not turn yellowish

CALICO PRINTERS SOAP

The calico printers use soap to clear the printed cloths from the thickening used during printing and for brightening the colour The soap for the purpose must be soluble in water without foul odour and quite neutral The presence of acids to an extent exceeding 0 2 per cent. is not allowable

The best oils to make soaps for this purpose are bleached palm oil and olive oil In

their absence coconut oil or castor oil may be used but the soap has often got an offensive smell No rosin is used in the preparation of this soap The soap should be soluble so that the soap can be washed out after treatment

The soap should be made carefully Complete saponification is necessary by boiling on strength (*p 60*) and finally it is to be made neutral by fitting (*p 61*)

SILK SOAP

This is intended to free the raw silk from the gummy matter it naturally contains The soap should be soluble in water and contain free alkali not more than 0 4 per cent Olive oil is the best ingredient to be used Coconut oil may also be used but the soap is hard to be neutralised and is not quite odourless Groundnut oil may be used for the purpose The soap should be fully saponified and leave no fat unconverted

OYERS SOAP

The soda soaps or hard soaps are chiefly used in dyeing The soap must be neutral *i e* it should be free from unsaponified fat and it should not contain any uncombined alkali

MONOPLE SOAP

Monople soap is largely used by the dyers to brighten shades Addition of $\frac{1}{2}$ to 1 per cent of the soap while dyeing substantive dye

stuffs, especially when hard water is available, gives excellent results The special claim made for it is in respect of its use in place of Turkey red oils in the dyeing and printing of cotton goods and finishing of textile fabrics

The soap is prepared by heating the sulphonated oil (obtained on treatment of castor oil with sulphuric acid) with alkali Care should be taken to finish the soap neutral or slightly acidic so that it is not affected by direct solutions of acids or concentrated salt solutions

The soap, if properly done, should not form precipitate with lime and magnesium salts, because the salts formed are soluble in excess of the soap The product is not precipitated when used in the dye bath as in the case of the ordinary soap, nor is it deposited upon the fibre

CASTOR OIL SOAP FOR PARA RED

Mix 20 lbs castor oil (of the first pressing) with 17 lbs caustic soda lye, 22°Be, and boil for 1 hour, allow the soap to cool for about 5 hours, then add 4 lbs 14 oz hydrochloric acid, 20°Be, boil for ½ hour, allow to cool, and syphon off the salt solution

MARSEILLES SOAP

The best Marseilles Soap is a green olive oil soap, made from sulphonated olive oil This is made to contain 62 to 64 per cent of

oil, with a corresponding proportion of alkali and water In the absence of olive oil tallow or coconut oil may be tried

Olive oil soaps are fairly soluble, and leave no unpleasant odour behind them They are employed in dyeing with substantive dyestuffs and in soaping dyed materials

DYE SOAP

I

Dye soap is prepared by taking 1 lb of common white or coloured yellow soap, mixing with it aniline 1 drm and dissolving it in 2 oz of gin and 2 oz of water, then working up the mass in a clear paste and moulding it to the desired shape with stamps on.

II

Melted soap	1	cwt
Aniline dye	1	lb
Boracic acid	3	%
Glycerine	5	%
Egg albumen	1	%

Dissolve the boracic acid in boiling water, crutch well in the melted soap then crutch in the colour and glycerine mixed with the albumen When the soap is nearly cold, run into moulds

CHAPTER XVI

MISCELLANEOUS SOAPS

DRY CLEANING SOAP

	Parts by weight
Oleic acid	5
Caustic potash	1
Methylated spirit	4

Mix oleic acid and caustic potash and stir until an emulsion is produced Then dissolve it in methylated spirit These quantities are arranged to produce a soap freely soluble in benzine By increasing the quantity of oleic acid the solubility of soap in benzine is increased.

METAL POLISHING SOAP

A good polishing soap may be made by mixing 100 lbs of coconut oil soap (with sufficient water to make it fluid) 10 lbs tripoli powder, 5 lbs of alum, 5 lbs of cream of tartar, and 5 lbs of dry whiting These should be pulverised together and cast into cakes

PETROLEUM OR PARAFFIN SOAP

Soaps from paraffin oil (and other mineral substances) are made by crutching into a soap paste 10 to 20 per cent of petroleum oil The addition of these products to a laundry soap

appears to increase its detergent effect, and greasy clothes in particular are more readily washed with paraffin soap than with an ordinary soap Sometimes the mineral oils are not used, but instead a soft low class, and somewhat oily paraffin wax is employed on account of the odour being less

DEPILATORY SOAP

The following is a good recipe for a soap meant to remove hair

453 grms glycerine 907 grms fat (cocoanut oil) and 1844 grms castor oil are saponified with 1914 grms 33 per cent caustic potash lye, the soap is then filled with 113 grms starch and 907 grms sulpho hydrate of sodium, and perfumed with 113 grams citronella oil

SADDLE SOAP

To make saddle soap gently heat over a slow fire constantly triturating till thoroughly incorporated 1 lb of beeswax 8 oz of soft soap 2 oz of linseed oil and ½ pint of oil of turpentine, put in pots or tins Rub very well into the saddle and finally polish with a soft brush

DOG SOAP

Petroleum	50 grms
Wax	40 grms
Alcohol	50 c c.
Good laundry soap	150 grms

Heat the petroleum wax and alcohol in a water bath until they are well mixed and dis solve in the mixture the soap cut into fine shavings and lastly pour into wooden moulds

STAIN REMOVING SOAP

Take 100 lbs of talc made to a paste with weak solution of carbonate of potash and mix this with 1 000 lbs of rosin grain soap by heat When cool enough add 4 lbs of turpentine and 3 lbs of benzine Finally mould as usual

SCOURING SOAP AND POWDER

Scouring soaps are generally made on a coconut oil base The soap after saponifica tion is drawn to a crutcher silex (grit) is mixed with it and the mass dropped into an asbestos jacketed kettle or tank and run into slate moulds to harden each mould being the size and shape of the finished soap

Scouring powder is made by mixing vary ing amounts of soap powder silex (grit) talc and sometimes a small amount of sal ammoniac

SCOURING SOAP

	Olive oil	2 lbs
	Oleic acid	2 lbs
	Tallow	2 lbs
	Water	½ lb
(1)	Caustic soda lye 40°Tw	5 lbs
(2)	Caustic soda lye 25°Tw	5¾ lbs

Put the oils and fat in a pan fitted with open steam, run in the water, turn on steam and start in the No 1 lyes Keep up gentle boiling till whole of the lye is run in boil for about 2 hours Now add the No 2 lye gradually boiling for another 2 hours Add sufficient common salt to set free the half spent lye boil till the lyes are quite free from goods, let rest all night and run off through a valve fitted at the bottom of the pan Now turn on again open stream and boil for another 2 hours Lastly allow it to rest till next day when it is ready for the frames

PEROXIDE SOAP

Many efforts have been made to manufacture soaps containing active oxygen as such soaps have valuable disinfecting and bleaching properties According to one method coconut oil prior to its use in the manufacture of soap by the cold process is treated with ozonised air The soap manufactured from this product has an oxidising and antiseptic action and is free from the peculiar smell of coconut oil According to another method the free fatty acids are used and these are allowed to act at 100°C upon alkali salts of peracids such as sodium percarbonate perborate persulphate etc It is very remarkable that these persalts are not decomposed at 100°C during the operation The soap thus obtained has bleaching and disinfecting properties

CASTILE SOAP

Olive oil	550 lbs
Palm oil	1000 lbs
Tallow	350 lbs
Cottonseed oil	350 lbs

Take half the lye at 28°Tw , and the other half of lye at 42°Tw Put the lye, say 150 gallons at 28°Tw into the pan, heat by steam or fire to about 150°F add the oil and agitate until it commences to boil Boil say, 3 or 4 hours, or until the oil has taken up the whole of the alkali Then throw in salt until the oil has taken up the whole of the alkali Then throw in salt until the soap separates allow the spent lye to settle to the bottom of the pan and draw off Kindle the fire, again and when boiling add gradually say 20 to 30 gallons lye at 42°Tw at a time until the soap begins to boil clear and continue adding the lye until finished Now cut the soap and draw off the spent lye—this contains the glycerine—when settled Boil up again briskly and add a little water, this is to wash the soap and give it a clear marble like appearance

CURD SOAP

Curd soap (*p 6*) is prepared by saponifying ordinary tallow with caustic soda (*p 55*) On the completion of the operation the mass is grained out (*p 58*) with salt The soap separates out from the waste lye which settles at the bottom of the pan The pan is set aside

for a few hours and the waste lye is with drawn The soap is next boiled with stronger lye The soap opens and appears like curd separating from the milk The lye runs off from the soap which is insoluble in moderately strong alkaline solution When the soap acquires a proper consistency the curd is allowed to settle for a while and then put into frames and allowed to cool

MARINE SOAP

Marine soaps are for use in the sea and as such they should be soluble in sea water These soaps contain as much as 80 per cent water

Marine soap is usually made from coconut oil and cotton seed oil or groundnut oil The soap is usually made by the cold process or the semi boiling process and is filled with large quantities of brine and carbonate of soda to increase the hardness and with silicate of soda to increase the detergent action When the semi boiling process is followed it is usual to boil the soap after liquoring (*p 110*) The soap is well crutched and then framed

Coconut oil	5 seers
Caustic soda lye 62°Tw	2¾ seers
Salt brine 20°Tw	4 seers

Put the coconut oil into a suitable vessel and apply heat Add the lye gradually and continue heating after saponification has taken place, which should be in about two hours, add

the salt brine to the soap in the vessel, boil for half an hour, and it is ready for the frames

SAND SOAP

Saponify 50 lbs of coconut oil with 100 lbs of soda lye of 20°Be The soap is then hardened by the addition of about 8 lbs salt dissolved in water to a density of 15°Be with the addition of 6 to 8 lbs soda ash Cover up and allow to cool After standing 5 to 6 hours the fob is skimmed and the soap mass is put into frames 100 to 150 lbs of dried and sifted salt is then crutched in, which should be continued till the soap cools The soap is very firm and hard and must be cut as soon as cooled To perfume the mixture add oil of lavender, oil of thyme and oil of coriander, each 100 grms

VASELINE SOAP

Take 160 parts coconut oil, 20 parts vaseline 76 parts of lye of 40°Be and 4 parts water and proceed as usual

TANNIN SOAP

Dissolve 30 lbs tallow soap, add 2 lbs of tannic acid and enough starch to form the mass into cakes

CARPET SOAP

To make carpet soap take fullers' earth 40 oz , spirit of turpentine 1 oz and pearl ash

8 oz Rub smooth, and make into a stiff paste with a sufficiency of soft soaps

OATMEAL SOAP

Take white soap 25 lbs, coconut oil soap 16 lbs, and remelt and crutch in 6 lbs of coarse ground oatmeal

HONEY SOAP

Take curd soap 900 parts, potash soap 100 parts and oil of citronella 15 parts Melt together and add a sufficient quantity of burnt sugar colouring to produce a light brown colour If genuine honey soap is wanted, 100 parts of clarified honey may be substituted for the potash soap

FLEECE WASHING SOAP

Caustic potash	½ ton
Soft water	½ ton
Tallow	2 tons

Take a 20 lb can of caustic potash in an iron or earthenware vessel with 20 lbs of water, the mixture must be used only warm or about 90°F Melt 80 lbs of tallow free from salt, the heat of this must be about 120°F Now pour the potash lye gently into the tallow, stirring it with a wooden spoon Pour off into mould

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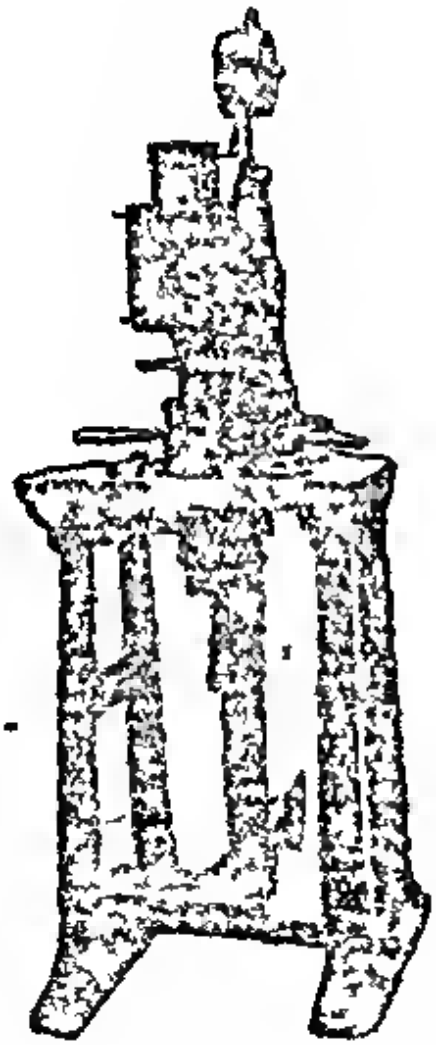

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